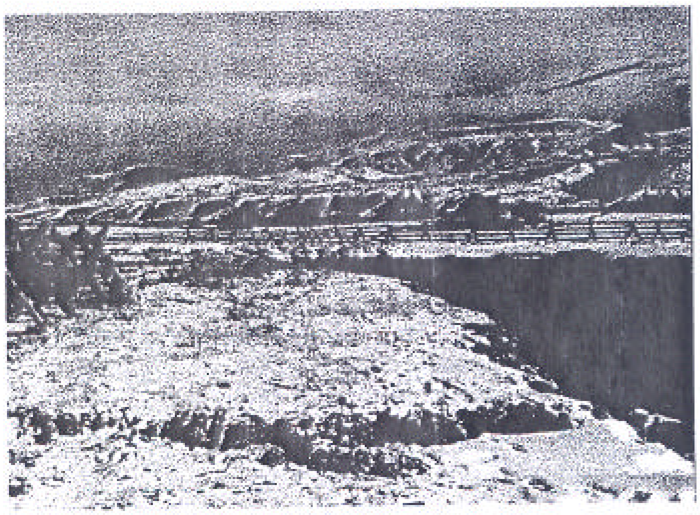
Lemhi River Watershed TMDL



December 1999

An Allocation of Nonpoint Source Pollutants in the Water Quality Limited Watersheds of the Lemhi River Valley

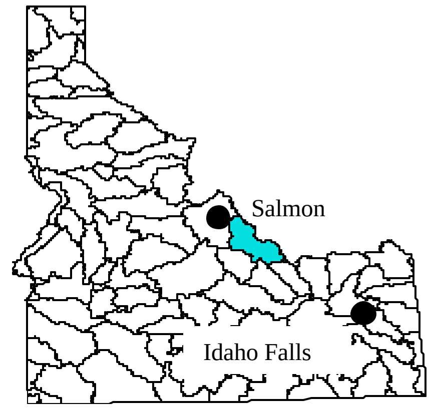
Idaho Department of Health and Welfare

Division of Environmental Quality

1410 North Hilton

Bosie, ID 83706

Total Maximum Daily Load (TMDL)
17060204 **Lemhi Subbasin TMDL**
December 1999



WQ CONCERNS AT A GLANCE:

Subbasin: ***Lemhi River***
Watershed Identifier: ***17060204***
Parameters of Concern: ***Sediment, Fecal Coliform Bacteria Concentrations***
Key Resources: ***Chinook Salmon***
Steelhead Trout
Bull Trout
Westslope Cutthroat Trout
Uses Affected: ***Salmonid Spawning, Coldwater Biota, and***
Primary and Secondary Contact Recreation
Sources Considered: ***NPS-Livestock grazing, Surface Irrigation return,***
Altered Riparian Condition, Unsurfaced Roads

Water Body	*Pollutants Addressed*
Lemhi River	***Fecal Coliform Bacteria***
Bohannon Creek	***Sediment***
Eighteenmile Creek	***Sediment***
Geertson Creek	***Sediment***
Kirtley Creek	***Sediment***
McDevitt Creek	***Sediment***
Sandy Creek	***Sediment***
Wimpey Creek	***Sediment***

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Acknowledgements

A TMDL is a huge undertaking and would not have been possible without the help of numerous people. DEQ would like to specifically thank Vince Guyer and Scott Feldhausen from the BLM, Upper Columbia-Salmon Clearwater District for their assistance on the many stream erosion inventories. Jim Fitzgerald, EPA Boise, for insight and guidance, Don Essig, IDEQ for his bacterial loading analysis, and numerous technical reviewers and consultants, both State and Federal, especially Chris Mebane, IDEQ and the Model Watershed. Members of the public, including the Salmon Basin Advisory Group, and the Lemhi Watershed Advisory Group, for their patience and input during the multiple iterations endured during the evolution of this TMDL. Also, members of the general public were invaluable during the comment period. Of course no document would be possible without the time and effort of the Idaho Falls DEQ clerical staff and their photocopier insights and support.

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1.0 Lemhi River Subbasin TMDL Executive Summary

Background

The 800,000+ acre Lemhi River Watershed is located in eastern central Idaho with its terminus at the Salmon River in Salmon, Idaho. The subbasin falls entirely within Lemhi County, Idaho. Land ownership in the subbasin is predominately federal (78.7%) with only 18.2% in private ownership. The State of Idaho manages the remaining 3.1%. Federal agencies also manage the majority of the stream miles (67.7%) with 28.7% under private management and the remaining 3.6% under State management.

The Lemhi River has been identified as critical spawning and rearing habitat for two federally protected anadromous species: steelhead trout (*Oncorhynchus mykiss)*, and spring/summer chinook salmon *(Oncorhynchus tshawytscha)*. The Lemhi River and its tributaries are also important historic and/or current habitat for federally protected resident and migratory bull trout (*Salvelinus confluentus)* as well as westslope cutthroat trout (*Oncorhynchus clarki lewisi*), which have been petitioned for listing under the Endangered Species Act. Also non-anadromous rainbow trout (*Oncorhynchus mykiss)* are found in the Lemhi River and its tributaries.

Section 303(d) of the Clean Water Act requires that states systematically evaluate water quality and every two years list waters that do not meet water quality goals that relate to support of beneficial uses. For streams that do not support beneficial uses, then more focused water quality evaluations are required to estimate the maximum amount of a given pollutant that a body of water can assimilate without violating water quality standards. This process is referred to as estimating the "total maximum daily load" or TMDL for a pollutant for that water.

The Lemhi River Subbasin Total Maximum Daily Load (TMDL) has been developed by the Idaho Division of Environmental Quality (IDEQ) and is intended to address water quality concerns on 7 streams and the Lemhi River. These surface waters within the subbasin that have been identified as having a beneficial support status less than Full Support. Two additional streams that are listed as water quality impaired will not have TMDLs written because they are dewatered for irrigation.

The Lemhi River Subbasin Assessment (IDEQ, 1998) is intended to identify water quality concerns throughout the Lemhi River watershed and to serve as an adaptive Water Quality Management Plan (WQMP). Within the Subbasin Assessment the primary anthropogenic source of sediment having a deleterious effect on beneficial use support status within the 7 TMDL streams listed for sediment was identified as sediment from streambank erosion. Within Wimpey Creek specific gullies and mass wasting features have been identified as additional sediment sources. Within McDevitt Creek a specific gully is identified as a sediment source in addition to streambank erosion. Within other watersheds gullies and mass wasting features were not identified as significant sources unless specifically stated. Lesser sources include some unsurfaced roads that are specifically identified within subwatershed TMDL sections where applicable.

A TMDL has been developed to address sediment in Bohannon Creek, Eighteenmile Creek, Geertson Creek, Kirtley Creek, Sandy Creek, McDevitt Creek, and Wimpey Creek, and to address fecal coliform bacteria in the Lemhi River. Though Bohannon, Eighteenmile, Geertson, Hawley, Mill, Sandy and Wimpey Creeks are listed for nutrients as pollutants of concern, no conditions within the streams have been observed that necessitate the writing of a TMDL for nutrients based on narrative state water quality standards.

Specific sources of fecal coliform contamination have not been identified within the Lemhi River Subbasin Assessment or the Lemhi River TMDL. The existing data used in the Subbasin Assessment and TMDL was collected by the Idaho State Department of Agriculture in cooperation with the Lemhi Soil and Water Conservation District and focussed on the mainstem Lemhi. Within the Lemhi TMDL a gross allocation of bacteria based upon sampling sites is used, and an overall percentage reduction of fecal coliform bacterial loading is identified to comply with current state water quality standards,. Specific bacteria sources will be identified through additional data collection conducted by NRCS (US Department of Agriculture – Natural Resources Conservation Service) and ISCC (Idaho Soil Conservation Commission) as part of the TMDL Implementation Plan. This sampling will occur over a 3 year period beginning in 2000 as agreed upon at the September 8th Salmon Basin Advisory Group meeting in Salmon, Idaho. This site specific source identification will enable site specific BMPs (best management practices) to be implemented to achieve the reductions outlined within this TMDL.

Water rights for irrigation are legally protected property rights under State law as described under Title 42 of the Idaho Code. Flow related water quality impairment will not be addressed as part of the Lemhi River Watershed TMDL since §303(d) of the Clean Water Act only requires TMDLs be calculated for those "pollutants" which the administrator of EPA has identified as suitable for such calculation in 303(d)(1)(C). The administrator of EPA identified all pollutants as suitable for TMDL calculation in 43 fed. Reg. 60662 (Dec. 28, 1978). Therefore, whether a TMDL must be calculated depends upon whether a "pollutant" as defined in the Clean Water Act is involved. The definition of "pollutant" in §502(6) of the Clean Water Act includes a number of listed materials and categories of materials. The alterations of water flow and aquatic habitat are not among those items specifically identified as a pollutant in the definition, and also do not fit within any of the general categories of pollutants, such as industrial and agricultural wastes. In addition, EPA, in its comments on Idaho's 1998 Draft 303(d) list, appears to agree that the alterations of flow or habitat are not pollutants.

The Lemhi River TMDL builds upon the Lemhi River Subbasin Assessment which functions as a WQMP prepared for the Principal Working Group of the Lemhi County Riparian Conservation Agreement by the Bureau of Land Management (BLM) and the IDEQ for the Lemhi River Watershed (IDEQ, 1998). The Lemhi River Subbasin Assessment WQMP addresses basic elements described in *"Guidance for Water Quality-based Decisions: The TMDL Process"* issued by the US Environmental Protection Agency in April 1991.

Water Quality Concerns
Excessive sedimentation is reducing the quality of spawning and rearing habitat for resident trout species and exceeds the same habitat parameters for anadromous species. Fecal coliform bacteria loading threatens primary and secondary contact recreation in the Lemhi River. Altered flow conditions resulting from diversion of surface waters for irrigation have eliminated migratory components of resident fish species and have elevated risks to isolated fish populations. The wide disconnection of tributaries from the Lemhi River within the watershed, however, increases the importance of recovering beneficial use support for cold water biota and salmonid spawning as a mechanism to reduce the inherent risks to fish populations from lack of connectivity.

Actions to Date
Both the TMDL and the Lemhi River Subbasin Assessment WQMP were developed, in part, from the Lemhi River Watershed Assessment issued by the BLM in 1991. Subsequently Idaho's Model Watershed Project was established in 1992 as part of the Northwest Power Planning Council's plan to rebuild Columbia River salmon runs through efforts to protect and restore important salmon and steelhead habitat on three Salmon River tributaries: the Lemhi, Pahsimeroi and East Fork of the Salmon River. The Model Watershed Plan that included the Lemhi was finalized in November of 1995 and identifies actions within the watershed that are planned or needed for salmon habitat, and establishes a procedure for implementing habitat-improving measures. This project has been very successful at improving anadromous fish habitat through planning, design and implementation of improved water diversions, regulatory structures, grazing plans, fencing and instream structure enhancement. In support of the Model Watershed Project the US Geological Survey, in cooperation with the Bureau of Reclamation, with assistance from the Lemhi Soil and Water Conservation District and the Lemhi Irrigation District, developed the *Surface-Water/Ground-Water Relations in the Lemhi River Basin, East-Central Idaho* in 1998 to help Federal, State and local agencies meet the goals of the Model Watershed Plan.

In 1994, county government, state and federal agencies, the Shoshone-Bannock Tribes, special interest groups and private citizens met to develop a cooperative approach to resolving riparian/stream habitat issues across all land ownership boundaries in Lemhi County. Two years later, the Lemhi County Riparian Habitat Conservation Agreement (CA) was entered into between the Lemhi County Commissioners, state and federal agencies, the Shoshone-Bannock Tribes and various citizens groups.

The stated purpose of the CA is developing coordinated efforts to avoid, minimize and/or mitigate risks to riparian habitat, which is crucial to the majority of listed or potentially listed species in the area, through a conservation strategy to enhance and maintain specific riparian habitat in Lemhi County. Essentially, the CA is a local land-use planning effort. As a result of the CA, work with land-use planning and local committees working with various federal agencies have solved seemingly insurmountable problems. Due to the general nature of the Lemhi County land use planning effort, regarding riparian management and water quality maintenance, the avenue for implementing restoration is the cooperative input from the CA to emphasize the multiple use philosophy and the importance of agriculture to the area economy. The Lemhi County

Riparian Habitat Conservation Agreement Working Group has accepted the responsibilities of serving as the Watershed Advisory Group to the Division of Environmental Quality for development of the *Lemhi River Subbasin Assessment*, *The Lemhi River TMDL* and the *Upper Salmon River Bull Trout Problem Assessment* and subsequent Conservation and Implementation Plans for bull trout and water quality documents.

Section 4.0 of this TMDL lists specific signatory individuals and organizations participating in Model Watersheds and the Lemhi Riparian Habitat Conservation Agreement to which much credit is owed for existing improvements in: land and water use, water quality and improved communication among user groups.

Beneficial Uses Effected

In 1994, the IDEQ began a statewide program of monitoring habitat features, and macroinvertebrate and fish communities in streams to determine Beneficial Use Support Status through the Beneficial Use Reconnaissance Program (BURP). The Clean Water Act of 1972 states "…waters shall be protected for beneficial uses, which includes all recreational use in and on the water and the protection and propagation of fish, shellfish, and wildlife, wherever attainable." This rule, and the aquatic life and recreation uses listed, are intended to address the "fishable" and "swimmable" goals of the Clean Water Act (see Section 2.2). Monitoring results are used to identify streams needing water quality restoration.

Multimetric stream habitat and macroinvertebrate community indices are used to help interpret the results. Seven macroinvertebrate community metrics were combined into a macroinvertebrate biotic index (MBI), and 11 channel morphology, riparian and substrate features were combined into a habitat index (HI). Indices are used in the Waterbody Assessment Guidance (IDEQ 1996) to interpret HI and MBI scores to determine beneficial use support (Appendix B). Depending upon scores, beneficial uses are determined to be Fully Supported (FS) or to Need Verification (NV). Some streams are Not Assessed (NA) if conditions fall outside the definition of assessable streams given in the Water Body Assessment Guidance. Streams are rated as Not Full Support (NFS) if scores fall below thresholds set in the Waterbody Assessment Guidance.

The Lemhi River is protected for general use for: domestic water supply, agricultural water supply, cold water biota, salmonid spawning, primary (and secondary) contact recreation, and as a Special Resource Water. Beneficial uses effected in the Lemhi River are primary and secondary contact recreation. The Lemhi River is on the 1998 proposed §303(d) list for fecal coliform bacteria for its entire length from the confluence of Texas Creek and Eighteenmile Creek to its confluence with the Salmon River.

Bohannon Creek is protected for primary contact recreation, industrial water supply, wildlife habitat, and aesthetics, coldwater biota, salmonid spawning and agricultural water supply. Beneficial uses effected in Bohannon Creek are salmonid spawning and coldwater biota. Bohannon Creek is on the 1996 §303(d) list for nutrients and sediment from the BLM boundary to its confluence with the Lemhi River.

Eighteenmile Creek is protected for primary contact recreation, industrial water supply, wildlife habitat, aesthetics, coldwater biota, salmonid spawning and agricultural water supply. Beneficial uses effected in Eighteenmile Creek are salmonid spawning and coldwater biota. Eighteenmile Creek is on the 1996 §303(d) list for nutrients and sediment from its headwaters to its confluence with the Lemhi River.

Geertson Creek is protected for primary contact recreation, industrial water supply, wildlife habitat, and aesthetics, coldwater biota, salmonid spawning and agricultural water supply. Beneficial uses effected in Geertson Creek are salmonid spawning and coldwater biota. Geertson Creek is on the 1996 §303(d) list for nutrients and sediment from the BLM boundary to its confluence with the Lemhi River.

Hawley Creek is protected from its headwaters, at the confluence of Reservoir and Big Bear Creeks to the US Forest Service boundary for primary contact recreation, industrial water supply, wildlife habitat, cold water biota, salmonid spawning and agricultural water supply. Beneficial uses effected in Hawley Creek are salmonid spawning and coldwater biota. Hawley Creek is on the 1998 proposed §303(d) list for nutrients and sediment from the first irrigation diversion to its confluence with the Eighteenmile Creek. The listed segment is dewatered throughout the year and will not have a TMDL developed.

Kirtley Creek is protected for secondary contact recreation, industrial water supply, wildlife habitat, aesthetics, coldwater biota, salmonid spawning and agricultural water supply. Beneficial uses effected in Kirtley Creek are salmonid spawning and coldwater biota. Kirtley Creek is on the 1996 §303(d) list for metals contamination and sediment from the confluence of the North and East Forks of Kirtley Creek to its confluence with the Lemhi River. The TMDL will address sediment only as metals contamination was shown not to be a parameter limiting beneficial use support.

McDevitt Creek is broken into two segments. From the headwaters to the Bureau of Land Management (BLM) lower boundary (upper reach), it is protected for Primary Contact Recreation, Industrial Water Supply, Wildlife Habitat, Aesthetics, Coldwater Biota, Salmonid Spawning and Agricultural Water Supply. Beneficial uses for the upper reach have been determined to be fully supported and are unaffected. From the BLM lower boundary to the Lemhi River (lower reach), McDevitt Creek is protected for Industrial Water Supply, Wildlife Habitat and Aesthetics. Due to the fact that the stream channel is primarily dewatered over all but the upper one third mile of the lower reach, other beneficial uses are not designated or existing and therefore not effected. McDevitt Creek is on the 1998 proposed §303(d) list for sediment from the lower BLM/state boundary to its confluence with the Lemhi River.

Mill Creek is also broken into two segments. From its headwaters to the United States Forest Service (USFS) boundary, Mill Creek is protected for secondary contact recreation, industrial water supply, wildlife habitat, aesthetics, and cold water biota. From the USFS boundary to the Lemhi River Mill Creek is protected for secondary contact recreation, industrial water supply, wildlife habitat, aesthetics, cold water biota and agricultural water supply. The beneficial use effected in lower Mill Creek is coldwater Biota. Mill Creek is also largely dewatered below the USFS boundary. Mill

Creek is on the 1998 proposed §303(d) list for flow alteration, nutrients and sediment from the USFS/BLM boundary to its confluence with the Lemhi River. The listed segment is dewatered throughout the majority of the year for irrigation and will not have a TMDL developed.

Sandy Creek is protected for secondary contact recreation, industrial water supply, wildlife habitat, aesthetics, coldwater biota, salmonid spawning and agricultural water supply. The beneficial uses effected in Sandy Creek are salmonid spawning and coldwater biota. Sandy Creek is on the 1996 §303(d) list for nutrients and sediment from the BLM boundary to its confluence with the Lemhi River.

Wimpey Creek is protected for primary contact recreation, industrial water supply, wildlife habitat and aesthetics, cold water biota and agricultural water supply. The beneficial use effected in Wimpey Creek is coldwater biota. Wimpey Creek is on the 1998 proposed §303(d) list for nutrients and sediment from the BLM boundary to its confluence with the Lemhi River.

Lemhi River Subbasin Loading and Allocation Summary

Lemhi River Fecal Coliform Loading Analysis

A loading analysis was performed using in stream fecal coliform concentrations (cfu/100ml), measured at six sites over four years, and USGS flow data, from two gauging stations, on the Lemhi River. Because only one of the bacterial sampling sites corresponds to a gauging station, river flows at five other sites were estimated.

Existing fecal coliform loads were calculated from estimated flows and measured concentrations. Bacteria concentrations in the Lemhi River are weakly but significantly correlated with flow at three of the six sampling sites. The concentrations and resulting loads at all stations are highly variable through the course of the runoff hydrograph, but generally peak during the high flows of early summer.

Load capacity was considered at both Idaho’s acute and chronic water quality criteria for fecal coliform. To simplify the analysis, the intermediate criterion was assumed to be met if the chronic criterion was met. The two criteria evaluated differ for the primary contact recreation season (May through September) and the secondary contact season (remainder of the year). Because of the probable relation of bacteria concentrations to flow, load capacity was further examined under high and low flow conditions.

High flow was defined by the peak in 90th percentile of 15 day running average flow. This was flow threshold was evaluated during the period of 23 May through 5 July, the peak in the average runoff. Low flow was defined by the 10th percentile of 15 day running average flow. This flow threshold was applied to the months of August and September, when Lemhi River flows are typically at a minimum. Because the River was not actually sampled at these flows, regression equations were used to predict bacteria concentrations, and thus loads, under these flow scenarios.

The analysis predicted daily loads (acute criterion) at low flow never exceed daily capacity. On the other hand, predicted daily loads at high flow do exceed daily capacity during the runoff period. When the chronic criterion (geometric mean) was examined predicted loads exceed capacity under both high and low flow conditions, but the degree and frequency of exceedance is greater under high flow.

Reductions in loads necessary to just meet the chronic criteria ranged from 17 to 63% during low flow, and 85 to 95% during high flow. The ranges represent differences among sampling sites. When the data were broken down by year, the necessary load reductions to meet chronic criteria for dates actually sampled ranged from 77 to 90% during low flow, and 79 to 92% during high flow. This change is due to year-to-year variations in bacteria concentrations, weak correlations, and above average summer flows over recent years when bacteria sampling occurred.

To account for a lack of understanding of bacterial loading sources, instream viability of bacteria and high variation observed in bacteria concentrations, an explicit 20% margin of safety in the target bacteria concentrations was added at the end of the analysis. This has the effect of increasing needed load reductions, to 82 to 92 % during low flow and 83 to 94 % under high flow. Because of the uncertainties involved, it is unlikely that a 10 or 11% range in load reduction represents any real differences in the level of control from segment to segment along the river.

Lemhi River Tributary Sediment Loading Analysis

A loading analysis was performed on §303(d) streams, and associated sediment producing roads, identified for sediment TMDL development in the Lemhi River subbasin. The loading analysis was done using streambank erosion inventories refined by the Natural Resources Conservation Service (Stevenson 1994) and applying the X-drain cross drain spacing and sediment yield model (Elliot *et al*. 1998). Existing streambank erosion loads were calculated from direct measurements collected in the inventory. Data was applicable and extrapolated to streambanks with similar channel characteristics (generally Rosgen channel type) and land management practices (including residential development, transportation corridors, irrigated agriculture, grazing, historic mining, timber harvest, and recreation). Streambank extrapolation and sediment producing unsurfaced and/or unmaintained roads closely associated with TMDL streams were evaluated using USGS 7.5-minute series topographical and mosaiced 3.75 minute digital orthophoto quadrangle (DOQ) maps to determine gradient and distance to the stream as well as land management conditions (Appendix E).

Load capacity is considered to be streambank erosion at streambank stability of approximately 80%. Load allocations are based upon the assumption that natural background sediment production equates to approximately 80% streambank stability as described in Overton *et al*. (1995), where stable banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability is generally at 80% stability or greater for A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types. Streambank erosion in excess of background was identified for load reduction and expressed as a percentage reduction of existing estimated streambank erosion load.

Depending on streambank erosion inventory sampling sites and the evaluated stream, reductions in loads necessary to meet the identified background level of sediment production were highly variable, from 0% to 95%, for streambank erosion. Road erosion reductions varied from 44% to 55% depending upon the distance to water, rounding and road gradient.

The current state of the science does not allow specification of a sediment or nutrient load or load capacity that is known in advance to meet the narrative criteria for sediment and to fully support beneficial uses for coldwater biota and salmonid spawning. All that can be said is that the load capacity lies somewhere between the current loading and natural background levels. We presume beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the initial loading capacity for sediment for Lemhi River subbasin sediment TMDL streams will be the natural background sediment load rate. Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in surface and subsurface fine sediment composition resulting from decreased sediment load, and to regularly monitor water quality and beneficial use support status. It is our intent to re-evaluate the sediment targets and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. As Best Management Practices (BMP) are identified and implemented, and monitoring shows that beneficial uses are fully supported, the loading capacity will be adjusted through adaptive management.

The Margin of Safety (MOS) applied to load allocations and resultant load reductions for Lemhi River subbasin sediment TMDL streams are implicit. The implicit MOS are the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include:

- Desired bank erosion rates and associated streambank recession rates are representative of background conditions;
- Cumulatively, the assumptions used in the X Drain (WEPP) model are conservative; and
- Water quality targets with regard to instream surface and depth fine sediment are consistent with values measured and set by local land management agencies based on established literature values, and incorporates an adequate level of expected fry survival to provide for stable salmonid production and sustained coldwater biota.

2.0 Watershed Assessment

2.1 Watershed Characterization

A complete characterization of the Lemhi subbasin can be found in the Lemhi River Subbasin Assessment (IDEQ, 1998). This watershed characterization is intended to serve as a succinct background within the Lemhi TMDL to frame the issues within the following sections for the individual TMDLs for the Lemhi River and its §303(d) listed tributaries. More localized watershed descriptions are included in the individual TMDL sections.

The 800,000+ acre Lemhi River sub-basin falls entirely within Lemhi County, Idaho. Land ownership in this sub-basin is predominately federal (78.7%), with only 18.2% in private ownership (Table 2.1.1). The State of Idaho manages the remaining 3.1%. Often the state parcels are managed in conjunction with federal or private grazing systems. The Lemhi River subbasin drains approximately 1,260 square miles encompassing the rugged 10,000+ foot Bitteroot range of the Beaverhead Mountains to the north and east, and the Lemhi Range to the west.

Table 2.1.1. Land ownership within the Lemhi River subbasin.

Lemhi River	**Total**	**BLM**	**USFS**	**State**	**Private**
Subbasin Acres	807,464	315,275	320,140	24,906	147,143
Mainstem Stream Miles	66	0	0	0	66
Subbasin Stream Miles	896.7	247.0	359.3	32.6	257.8
Percent Subbasin Acres	100%	39.0%	39.7%	3.1%	18.2%
Percent Subbasin Stream Miles	100%	27.6%	40.1%	3.6%	28.7%

The private lands in the Lemhi River subbasin are found primarily along watercourses where sufficient water allowed the more fertile and flat terrain to be developed. The primary uses are for agricultural development, which include fields of irrigated alfalfa, grass or pasture. These uses provide feed for cattle, sheep and some horses during the colder winter months. Irrigation water is diverted from the tributaries and the Lemhi River through diversion headgates, and either used for flood irrigating the fields or conveyed in a pipeline for sprinkler systems (hand lines and wheel lines). Homesites or ranchettes are common and, as the population in the area increases, developments are taking place on the agricultural areas.

The public lands administered by the BLM are generally located on the upper benches, above the creek or streams. These are generally steeper and rougher terrain and provide habitat for a variety of wildlife, both game and non-game species. The public lands also are used for livestock grazing, recreation, and a variety of other public uses.

Lands administered by the State of Idaho are generally Sections 16 and 36 within each township. These lands are scattered among public lands and are essentially used in a similar fashion to the public lands, being leased for grazing, timber harvest and mining activities by the Idaho Department of Lands (IDL).

Lands administered by the USFS are generally located on the higher forested slopes. These lands are used similar to the public and state lands, with grazing, timber harvest and recreation being the most dominant uses.

Federal agencies manage the majority of the stream miles (67.7%) in the sub-basin. These streams are often fairly small and although critical habitat for many species, are usually disconnected from the Lemhi River due to dewatering for irrigation. The health of the mainstem Lemhi River and the lowermost portions of it's tributaries, which are in private ownership, is crucial to the long term survival of most fish species, particularly the species listed under the Endangered Species Act; chinook, steelhead and bull trout.

One of the primary uses of the public land in this area is for seasonal livestock grazing. The BLM manages a total of 62 grazing allotments that have an allocated use of 47,234 animal unit months (AUMs) of forage. Livestock grazing generally occurs between May 1 and October 30, but some early spring and late fall and winter use is also authorized. A large percentage of the livestock operators use BLM public land for the entire grazing season. A smaller percentage of operators move onto USFS land for summer grazing, and then return to BLM land for fall use.

The USFS manages 32 allotments within the watershed, several of which are only small pastures grazed as part of a large private land parcel. These 32 allotments have an allocated use of 30,328 AUMs for forage. Of the 94 allotments within the watershed, 24 of these are managed cooperatively by the BLM and USFS. In this process, the two agencies may work together to manage a large piece of ground where both have allotments, or one agency may manage the grazing on a piece of ground administered by the other.

Pursuant to §303(d) of the Clean Water Act, states are required to identify and prioritize water bodies that do not meet state water quality standards for beneficial uses. The designated beneficial uses on the Lemhi River are coldwater biota, salmonid spawning, primary contact recreation, domestic and agricultural water supply, industrial water supply, wildlife habitat, and aesthetics.

The states must publish this list of water bodies (§303(d) list) and TMDLs for pollutant levels that will allow water quality standards to be met and beneficial uses to be fully supported. TMDLs are management plans, which identify pollutants and allocate amounts to each use, at reduced levels, which will result in meeting state water quality standards within a stated time frame.

In 1994, the Environmental Protection Agency (EPA) published a list of stream reaches with impaired water quality. Fourteen reaches on this §303(d) list were from the Lemhi

River subbasin. The 1998 proposed §303(d) list reduced this list to seven reaches, including the main Lemhi River. The source of problems does not always occur on the listed reach; the source of the pollutant may be upstream, with the effect noted in the listed reach. Also, some portions of the listed reach may be in good condition.

Climate

The climate of the basin is quite varied, with changes in elevation from 4,100 feet above mean sea level (amsl) to 11,000 feet amsl contributing to this variation. Annual average precipitation ranges from 7 inches at lower, drier elevations to 23 inches at higher elevations. Most of this occurs during winter months in the form of snow and in the spring and fall as rain. Severe winters with 6 or more feet of snow on the ground occur at higher elevations while snow accumulations at lower elevations vary (Appendix C).

Climatic records from the Salmon area, for the period 1967 to 1997 (temperatures) and 1917-1996 (precipitation), show the following (NOAA file data):

- Average annual temperature = 45.6 degrees F
- Maximum temperature = 105 degrees F
- Minimum temperature = -34 degrees F

- Average annual precipitation = 9.4 inches
- Maximum annual precipitation = 14.8 inches
- Minimum annual precipitation = 3.6 inches

Climatic records from the Leadore area show the following:

- Average annual temperature =36 degrees F
- Maximum temperature = 99 degrees F
- Minimum temperature = -38 degrees F

- Average annual precipitation = 7.5 inches
- Maximum annual precipitation = 10.7 inches
- Minimum annual precipitation =6.2 inches

Hydrology

The Lemhi River is a low gradient, spring-fed system that flows through fertile valley bottoms. The average flow of the Lemhi River, for the years 1955-1990, is 270 cubic feet per second (cfs) at the gauging station location just below the mouth of Hayden Creek. Peak flows generally occur in June (as high as 550 cfs) and the lowest flows are experienced in August (often less than 100 cfs) (Irrigators Plan 1992). A more detailed description of flow characteristics for the Lemhi River is contained in the Lemhi River TMDL section (Section 3.1).

The hydrology of much of the Lemhi River has been changed dramatically since the mid-1840's, beginning with intensive beaver trapping and dam removal efforts, and continuing today with extensive irrigation diversions and related channel alterations including the construction of Highway 28 on an old railroad bed. Channelization, diversion of tributary streams and a lack of connectivity to the floodplain has changed the hydrograph of the system from one where beaver dams and a sinuous, meandering stream channel kept most water storage within the system itself, to one where most storage is off channel on the irrigated lands. It has also decreased seasonal fluctuations in flows, reducing the ability of the river to maintain historical characteristics, reducing deep pools and meanders which provided necessary fish habitat (IDEQ, 1998).

The Lemhi River and nearly all of its tributaries are entirely or significantly diverted for irrigation purposes between late April and the end of October. Claims on the major tributaries for the 30 watersheds presented in the Lemhi River Watershed and Subbasin Assessment (IDEQ, 1998) total 787.4 cfs. Many of the tributaries only reach the river during spring runoff. Seasonal variations in water quantity have a severe effect on fish populations and movement as well as riparian vegetation within the watershed. Water rights in the Lemhi River subbasin were adjudicated in 1978; several reports (Ott Water Engineers 1985, Haws *et al*. 1977, Chapman 1988) detail the hydrology of the subbasin and evaluate the effects of water withdrawals on the hydrology and fisheries needs.

The annual water yield for the Lemhi system has been estimated at approximately 1.1 million acre-feet. The average annual flow at Salmon is 180,000 acre feet. The difference is lost to evaporation, vegetative transpiration and underground flows (Haws *et al*. 1977). There are only seven deep groundwater wells used for irrigation in the subbasin (Model Watershed Plan 1995). The relationship between deep and shallow groundwater and surface water is not well understood at this time. As of 1995, approximately 37,000 acres of land in the subbasin are irrigated, with 20% under sprinklers and the remainder flood irrigated (Model Watershed Plan 1995). By 1998 an estimated 72 diversions existed on the Lemhi River and tributaries with an extensive canal system for distributing irrigation water for crops and stock (USGS 1998). Combined with sprinkler irrigation, USGS (1998) estimates that by 1998 there was nearly 90,000 acres of cropland under irrigation in the Lemhi Watershed. Water used for irrigation returns to the Lemhi River in the form of springs directly entering the river, overland flow from ditches, and direct returns from ditches. Return flows are estimated to provide 8-14 cfs per mile to the Lemhi River, not including repeat diversion, (Ott Water Engineers 1985). In 1998 USGS estimated ground water return flow at 4.7 to 10.8 cfs per mile to the Lemhi River.

Historically, the Lemhi River meandered across the valley bottom, with complexes of beaver dams, willows, and thick stands of cottonwoods. The river has been straightened and riprapped in some places, and much of its former floodplain is now irrigated pastureland. To encourage people to move west, Congress passed the Homestead Act in 1862, the Desert Lands Entry Act in 1877, and the Carey Act in 1894 to give federal lands to farmers and the states for free or for a nominal price. Development of stream diversions for surface irrigation was encouraged by subsidized projects, and the necessity within the provisions of these laws for agricultural development. This began the pattern of water quality degradation and lack of surface water connectivity that today effects beneficial use support and fisheries value in the Lemhi River subbasin.

The largest riparian areas in the Lemhi River subbasin are on private land, because settlers characteristically chose to homestead along the river and major creeks. The BLM administers roughly 40% of the stream miles, but many of these creeks are relatively steep and narrow, with less potential for riparian vegetation development than the lower lying private lands. The USFS generally administers the headwaters of the creeks, on the forested lands above BLM lands. The most extensive stands of cottonwoods occur in a narrow band on the lower half of the Lemhi River. On the upper river, near Leadore, riparian vegetation widens out in wet meadows dominated by willows and sedges. Shrubs and aspen, with occasional cottonwoods, dominate side tributaries. Sedges dominate small areas around seeps and wet meadows (IDEQ, 1998).

Geology

The Lemhi River Sub-basin is the northernmost of the Basin and Range fault block valleys, and lies within the Northern Rocky Mountain physiographic province. The broad valley is bordered by steep-sided, narrow mountain ranges. Both the Beaverhead Mountains and Lemhi Range have cores of pre-Cambrian quartzite. The flank of the Lemhi Range is mantled with Paleozoic sediments from about Hayden Creek southward to Gilmore. These sediments consist of limestones and quartzites. North of Hayden Creek, the range is flanked by Tertiary (Challis) Volcanics.

The Beaverhead Mountains to the east are flanked by Miocene lakebed deposits from the Salmon River southward to Kenney Creek. A small area of Eocene to Miocene basin accumulations covers the area between Kenney Creek and Agency Creek. South of Agency Creek to approximately Mollie Gulch, sediments are generally Paleozoic limestone with a few additional windows of lakebed sediments. Windows of the lakebed sediments do not appear further south than Mollie Gulch. A large area south of Leadore known as Center Ridge is made up of Tertiary lakebed sediments.

The valley bottoms are covered by an unmeasured thickness of Cenozoic sediments consisting primarily of sand and gravel with varying amounts of finer sediments and/or boulders. Many of the deposits, especially in the Leadore area, are large alluvial fans.

Structurally, the range fronts are bounded by faults. A series of geothermal springs occurs along an active fault zone in the area of Wimpey and Sandy Creeks. Geothermal springs likely contribute to the natural temperature regime of some tributaries to the Lemhi River. Additional transverse faulting occurs throughout the ranges. Thrust faulting has juxtaposed many formations, especially southeast of Leadore. The range front faults appear to have acted as conduits for mineralizing fluids as evidenced by the concentration of prospecting/mining along range fronts.

From the standpoint of sediment sources, the greatest amount of natural background sediment appears to come from weathered volcanics and the poorly cemented silty and bentonitic fractions of the lakebed sediments. These occur primarily in the following areas: Reese/Peterson Creek, Alkali Flats/Pattee Creek, Hayden Creek/Basin Creek, and lower reaches of Bohannon, Kirtley, and Kenney Creeks. Major bentonitic areas occur within five miles of the town of Salmon and at Center Ridge, near Leadore. Additional anthropomorphic sediment sources are discussed for each stream TMDL section. The Lemhi River Subbasin Assessment (DEQ, 1998), describes soil characteristics for each watershed.

Fisheries

The Lemhi River subbasin supports a diverse community of game fish, including threatened bull trout (*Salvelinus confluentus*), petitioned Westslope cutthroat trout (*Oncorhynchus clarki lewisi*), threatened steelhead trout and resident rainbow trout (*Oncorhyncus mykiss*), and mountain whitefish (*Prosopium williamsoni*). It also provides spawning and rearing habitat for the endangered Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*) as evidenced by IDFG snorkel surveys (IDFG Tom Curet personal communication). Rearing habitat is the limiting factor to fish production and puts a greater restriction on salmon and steelhead production in the Lemhi River subbasin than does spawning habitat (Irrigators Plan, 1992).

Available rearing habitat in the Lemhi River was quantified and rated for condition in 1985 and again in 1994. Currently, it is estimated that there are 483,528 square yards of chinook salmon rearing habitat available in the Lemhi River and Hayden Creek. Under perfect conditions, the Lemhi River subbasin is estimated to be capable of producing 483,528 spring chinook smolts. However, stream alteration and channelization have reduced the quality of rearing habitat available. (Irrigators Plan, 1992). In recent years, IDFG chinook redd counts have ranged from 7 to 50 redds, which implies 15 to 110 spawning chinook. Observed optimal naturally produced smolt densities within the Lemhi River subbasin are estimated to be 25 smolts/100m^2 or less (Mike Larkin IDFG, Personal Communication). An after-harvest escapement of 3,789 chinook spawners would be needed to fully seed this rearing habitat if it was in optimal condition.

Hayden Creek, one of the few major tributaries to reach the Lemhi River year-round, until recently, supported sizable spawning populations of salmon and steelhead as well as bull trout. Historically, salmon and steelhead runs were supplemented by hatchery releases (IDFG *unpublished data*). There has been no hatchery supplementation of bull trout in the Lemhi River subbasin. No salmon redds were found in 1993-1994. Two redds were documented in 1995, with fish seen actively spawning on one. Between 1966 and 1982, a hatchery on Hayden Creek tested the rearing of steelhead and chinook salmon in dirt-bottom ponds. The hatchery experienced high mortality of green eggs due to excessive levels of zinc and copper in the spring water source. It was shut down in 1982, but is still used by IDFG as a research facility. Bear Valley Creek, a tributary to Hayden Creek, has the best spawning habitat in the Lemhi River system, but has been nearly devoid of fish since the 1980's (IDEQ, 1998).

Beginning in the late 1850's, chinook salmon were trapped along the Lemhi River and sold commercially. Anadromous fish runs were nearly lost at the turn of the century when a hydroelectric facility was constructed near the mouth of the Lemhi River. With the removal of the hydroelectric plant in the 1920's, salmon and steelhead returned, but to levels below the capacity of the system. This decline may be partially due to a Bureau of Commercial Fisheries egg-taking program which was stationed in Salmon during the 1930's. The program took eggs from Lemhi River fish and shipped them throughout the northwest, to the dismay of local residents who blamed the program for much of the subsequent decline. The station closed in 1940 due to an inadequate number of returning spawners. Spring chinook redd counts in the Lemhi River have steadily declined from an annual average of 961 between 1957 and 1967, to less than 100 redds from 1989 to 1993. The decline has continued through the mid-90's, reaching a low of 9 redds in 1995 and a high of 50 redds in 1997.

Bull trout (*Salvelinus confluentus*) were historically known to be found in Kirtley, Geertson, Kenney, Pattee, Hayden, Mill, Big Eightmile, Little Eightmile, Timber, Texas, Hawley, and Eighteenmile Creeks, their tributaries and in the Lemhi River itself. Current populations are generally limited to the headwaters of these systems due to seasonal dewatering for irrigation purposes. The migratory portion of the population has likely been severely diminished, if not lost entirely, because of this lack of connectivity to the Lemhi River tributaries. Redd counts and fry monitoring have not been conducted for bull trout, though electrofishing and snorkeling data have been collected to indicate the distribution and relative abundance of bull trout and other resident species.

Westslope cutthroat trout, (*Oncorhynchus clarki lewisi*) are found in almost every watershed of the Lemhi subbasin. The U.S. Fish and Wildlife Service (USFWS) has received a petition for proposal for listing of the westslope cutthroat. The species is on a decline throughout its range due to habitat loss, dewatering of migration corridor streams, spawning and rearing streams, sedimentation, elevated stream temperatures, and competition from introduced species. Some of the introduced species, such as rainbow trout, have affected the genetics of cutthroat stocks through hybridization which results in a fertile offspring with intermediate characteristics. Behnke (1992) suggests the Yellowstone cutthroat (*Oncorhynchus clarki bouvieri*) was the original cutthroat within the upper Salmon River watershed. It is thought that these were in turn displaced by rainbow trout (*Oncorhynchus mykiss*). The Westslope cutthroat may have become established through transfers from the Clark Fork River watershed.

Various individuals and government agencies throughout the century have stocked streams and lakes within the watershed. The IDFG started a regular stocking program in the late 1960's. They have planted five species of game fish of various strains and stocks during the last 25 years.

2.2 Water Quality Concerns and Status

Federal Requirements for Water Quality Limited Waters
The Federal Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters (Public Law 92-500 Federal Water Pollution Control Act Amendments of 1972). Each state is required to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the water whenever attainable.

Section §303(d) of the CWA establishes requirements for states to identify and prioritize waterbodies, which are water quality limited (i.e. waterbodies which do not meet water quality standards). States must publish a priority list of impaired waters every 2 years. For waters identified on this list, states must develop TMDLs set at a level to achieve water quality standards. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions. In essence, TMDLs are water quality management plans, which allocate responsibility for pollution reduction with a goal of achieving water quality standards within a specified period of time.

Surface Water Beneficial Use Classifications
Idaho's designated uses for surface waters include: 1) identification of beneficial uses; and 2) designation of waters for which beneficial uses are to be protected. The beneficial uses for surface waters in the Lemhi River subbasin, other than the Lemhi River, are addressed in section 101 of the Idaho Water Quality Standards, entitled "Undesignated Surface Waters." This section states that "Prior to designation, undesignated waters shall be protected for beneficial uses, which includes all recreational use in and on the water and the protection and propagation of fish, shellfish, and wildlife, wherever attainable." This rule, and the aquatic life and recreation uses listed, are intended to address the "fishable" and "swimmable" goals of the Clean Water Act. Section 101 also states that because most of Idaho's waters are presumed to support cold water biota and primary or secondary contact recreation, criteria to protect these uses only apply to all undesignated waters. This provision of Idaho's Water Quality Standards has caused confusion when relatively pristine warm waters, such as streams fed by warm springs, have been assessed as water quality limited because they do not support cold water biota. Such problems can be resolved by performing a beneficial use attainability study and designating the waterbody for appropriate beneficial uses. The following excerpt from Idaho'' water quality standards list the following beneficial uses for surface waters:

01. Water Supply.
   a. Agricultural: waters which are suitable or intended to be made suitable for the irrigation of crops or as drinking water for livestock;
   b. Domestic: waters which are suitable or intended to be made suitable for drinking water supplies;
   c. Industrial: waters which are suitable or intended to be made suitable for industrial water supplies. This use applies to all surface waters of the

state.

02. Aquatic Life.

a. Cold water biota: waters which are suitable or intended to be made suitable for protection and maintenance of viable communities of aquatic organisms and populations of significant aquatic species which have optimal growing temperatures below 18° C.
b. Warm water biota: waters which are suitable or intended to be made suitable for aquatic protection and maintenance of viable communities of aquatic organisms and populations of significant organisms and populations of significant aquatic species which have
optimal growing temperatures above 18° C.
c. Salmonid spawning: waters which provide or could provide a habitat for active self-propagating populations of salmonid fisheries.

03. Recreation.

a. Primary contact recreation: surface waters which are suitable or intended to be made suitable for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such waters include, but are not restricted to those used for swimming, water skiing, or skin diving.
b. Secondary contact recreation: surface waters which are suitable or intended to be made suitable for recreational uses on or about the water and which are not included in the primary contact category. These waters may be used for fishing, boating, wading, and other activities where ingestion of raw water is not probable.

04. Wildlife Habitats.

a. Waters which are suitable or intended to be made suitable for wildlife habitats. This use applies to all surface waters of the state.

05. Aesthetics. This use applies to all surface waters of the state.

All surface waters of the state are designated for the uses of industrial water supply, wildlife habitat, and aesthetics. In addition, Idaho has designated beneficial uses for most of the state's large rivers, lakes and reservoirs. Listed waterbodies may be "protected for general use" or "protected for future use."
Existing Beneficial Use of Existing Use is defined as: *Those beneficial uses actually attained in waters on or after November 28, 1975, whether or not they are designated for those waters in Idaho Department of Health and Welfare Rules, Title 1, Chapter 2, "Water Quality Standards and Wastewater Treatment Requirements."*

Designated Beneficial Uses of the Lemhi River and §303(d) Tributaries

Lemhi River Designated Beneficial Uses

The Lehmi River is protected for general use for: domestic water supply, agricultural water supply, cold water biota, salmonid spawning, primary (and secondary) contact recreation, and as a Special Resource Water. Special Resource Water is defined as: *A specific segment or body of water which is recognized as needing intensive protection to: a) preserve outstanding or unique characteristics, or b) maintain a current beneficial use (IDAPA 16.01.02.003.90). According to IDAPA 16.01.02, designation as a Special Resource Water recognizes at least one of the following characteristics:*

a) the water is of outstanding high quality;
b) the water is of unique ecological significance;
c) the water possesses outstanding recreational or aesthetic qualities;
d) intensive protection of the quality of the water is in paramount interest of the people of Idaho;
e) the water is a part of the National Wild and Scenic River System, is within a State or National Park or wildlife refuge and is of prime or major importance to that park or refuge; or
f) intensive protection of the quality of the water is necessary to maintain an existing, but jeopardized beneficial use.

The Lemhi River is on the 1998 proposed §303(d) list from its headwaters at the confluence of Texas Creek and Eighteenmile Creek to its confluence with the Salmon River. The primary pollutant of concern is bacteria (fecal coliform bacteria) which results in impairment of primary and secondary contact recreation beneficial use.

Bohannon Creek Designated/Existing Beneficial Uses

Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply. Bohannon Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses approximately the lower half of the creek. The listed reach on Bohannon Creek has been determined to Need Verification to show full support of salmonid spawning and coldwater biota beneficial uses. Sediment deposition as evidenced by percent subsurface fines exceeds desired values and conditions.

Eighteenmile Creek Designated/Existing Beneficial Uses

Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.

Eighteenmile Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses the entire length of Eighteenmile Creek from the headwaters. The listed reach on

Eighteenmile Creek has been determined to Need Verification to show full support of salmonid spawning and coldwater biota beneficial uses. Sediment deposition as evidenced by percent surface and subsurface fine particle composition exceeds desired values and conditions.

Geertson Creek Designated/Existing Beneficial Uses
Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.
The listed reach on Geertson Creek has been determined to Need Verification to show full support of salmonid spawning and coldwater biota beneficial uses. Increased sediment deposition as evidenced by percent surface and subsurface fines exceeds desired values and conditions. Geertson Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses approximately the lower half of the creek.

Hawley Creek Designated/Existing Beneficial Uses
Hawley Creek is also broken into two segments. Hawley Creek is protected from its headwaters, at the confluence of Reservoir and Big Bear Creeks, to the USFS boundary for primary contact recreation, industrial water supply, wildlife habitat and aesthetics designated beneficial uses. Existing beneficial uses include cold water biota, salmonid spawning and agricultural water supply. The remaining segment, from the USFS boundary to the confluence with Eighteenmile Creek, is protected for the same designated and existing beneficial uses. Approximately 1.25 miles below the USFS boundary Hawley Creek enters a permanent diversion to supply irrigation water to irrigated cropland and for stock watering. There is not a mechanism at this diversion to return flow to the natural stream channel, nor is there a diversion return below the permanent diversion to return water to the natural stream channel.

Hawley Creek is on the 1998 proposed §303(d) list from the permanent diversion to its confluence with Eighteenmile Creek. The pollutants of concern over the listed reach are sediment and nutrients witch would result in the impairment of the coldwater biota and salmonid spawning existing beneficial use. There is no longer a confluence of the natural channel with Eighteenmile Creek and a permanent diversion dewaters the natural channel throughout the year over the listed reach with the possible exception of the brief period of peak flows from snowmelt. Given the alluvial nature of the substrate, this ephemeral flow infiltrates long before it reaches the lowest point of diversion, and this infiltration prevents the confluence of Hawley Creek with Eighteenmile Creek.

Kirtley Creek Designated/Existing Beneficial Uses
Designated beneficial uses for the listed reach include secondary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.
Kirtley Creek is on the 1996 §303(d) list for sediment and metals contamination from its headwaters at the confluence of the North Fork of Kirtley Creek and the East Fork of Kirtley Creek to its confluence with the Lemhi River. This listing definition

encompasses approximately the lower 2/3 of the watershed. The listed reach on Kirtley Creek has been determined to Need Verification to show full support of salmonid spawning and coldwater biota beneficial uses. Sediment deposition as evidenced by percent subsurface fines exceeds desired values and conditions.

McDevitt Creek Designated/Existing Beneficial Uses
McDevitt Creek is also broken into two segments. From the headwaters to the BLM boundary it is protected for primary contact recreation, industrial water supply, wildlife habitat and aesthetics designated beneficial uses and coldwater biota, salmonid spawning and agricultural water supply existing beneficial uses. From the lower BLM boundary to the Lemhi River, the listed reach designated beneficial uses include protection for industrial water supply, wildlife habitat and aesthetics. Existing beneficial use protection is not applicable for this lower each because the channel is dry due to diversion for irrigation. There is a short reach from the lower BLM boundary to the first point of diversion, approximately 1/3 mile downstream from the boundary, which generally has flowing water to which the TMDL might be meaningful. McDevitt Creek is on the 1998 proposed §303(d) list from the lower BLM boundary to the Lemhi River. The primary pollutant of concern is elevated surface and subsurface fine sediment that would impair coldwater biota.

Mill Creek Designated/Existing Beneficial Uses
Mill Creek is divided into two segments for defining designated and existing beneficial use protection. From its headwaters to the USFS boundary, designated beneficial use protection includes secondary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial use protection includes cold water biota. From the USFS boundary to the Lemhi River it is protected for the same designed beneficial uses with existing beneficial use including cold water biota and agricultural water supply.

Approximately ¼ mile above the USFS/BLM boundary Mill Creek flow is diverted throughout most of the year. Below this point any remaining water enters a series of 4 other diversions within 0.8 miles from the upper most diversion. In the rare event that any remaining water passes the lower diversion, approximately 1/8 mile below the USFS boundary, flow quickly infiltrates into the substrate. Five site visits to the point of diversion described here between July and December in 3 subsequent years of the Lemhi River TMDL development period have shown dry stream channels below the points of diversion. The natural stream channel below the upper diversion, has water for a short duration during peak flow from snowmelt, however that water is quickly diverted or infiltrates into the substrate long before it makes any surface connection with the Lemhi River.

Mill Creek is on the 1998 proposed §303(d) list from the US Forest Service boundary to the Lemhi River. The pollutants of concern are sediment, nutrients and flow alteration that would impair the coldwater biota existing beneficial use for the listed segment of Mill Creek. In Idaho, water rights for irrigation are legally protected property rights under State law that are described under Title 42 of the Idaho Code. Additionally, §303(d) of the Clean Water Act only requires TMDLs be calculated for those "pollutants" which the administrator of EPA has identified as suitable for such calculation in 303(d)(1)(C). The administrator of EPA identified all pollutants as suitable for TMDL calculation in 43 Fed. Reg. 60662 (Dec. 28, 1978). Therefore, whether a TMDL must be calculated depends upon whether a "pollutant" as defined in the Clean Water Act is involved. The definition of "pollutant" in §502(6) of the Clean Water Act includes a number of listed materials and categories of materials. The alterations of water flow and aquatic habitat are not among those items specifically identified as a pollutant in the definition, and also do not fit within any of the gerneral categories of pollutants, such as industrial and agricultural wastes. A TMDL will not be written for Mill Creek related to flow alteration sediment or nutrients.

Downstream approximately 3.5 miles from the upper diversion on Mill Creek, is the confluence of the dewatered natural stream channel with Ferry Creek, and the flow from Ferry Creek also generally infiltrates over a short distance, before making a connection with the Lemhi River. Irrigation return water occasionally connects to the Lemhi River below this point through the natural stream channel, however flow is sporadic and not considered natural.

Sandy Creek Designated/Existing Beneficial Uses
Designated beneficial uses for the listed reach of Sandy Creek include secondary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply. Sandy Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses the lower two thirds of the creek. The listed reach on Sandy Creek has been determined to Need Verification to show full support of beneficial uses for coldwater biota and salmonid spawning. Sediment deposition as evidenced by percent surface fines exceeds desired values and conditions.

Wimpey Creek Designated/Existing Beneficial Uses
Designated beneficial uses for the listed reach of Wimpey Creek include primary contact recreation, industrial water supply, wildlife habitat and aesthetics. Existing beneficial uses include cold water biota and agricultural water supply. The segment of Wimpey Creek on the 1998 proposed §303(d) list is from the BLM boundary to the Lemhi River. The listed reach on Wimpey Creek has been determined to Need Verification to show full support of beneficial uses. This listing definition encompasses the lower half of the creek. The primary pollutants of concern are sediment and nutrients that would impair coldwater biota.

Water Quality Criteria
Idaho water quality standards for sediment state that: *Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses.* There are no references to sediment quantities in section 250. In addition, a numeric turbidity criterion (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed

background by more than 50 Nephelometric Turbidity Units (NTU) instantaneously or more than 24 NTU for more than ten consecutive days.

Idaho water quality standards that related or could be interpreted to relate to nutrients state that "*Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of ant kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.*"

Idaho water quality standards that relate to bacteria are specific to fecal coliform bacteria and are numeric and state:

"Primary Contact Recreation: between May 1 and September 30 of each calendar year, waters designated for primary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

I. 500 colonies/100 ml at any time; and
II. 200 colonies/100 ml based on a minimum of five (5) samples taken over a thirty (30) day period; and
III. a geometric mean of 50 colonies/100 ml based on a minimum of five (5) samples taken over a thirty (30) day period.

Secondary Contact Recreation: waters designated for secondary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

I. 800 colonies/100 ml at any time; and
II. 400 colonies/100 ml in more than ten percent (10%) of the total samples taken over a thirty (30) day period; and
III. a geometric mean of 200 colonies/ 100 ml based on a minimum of five (5) samples taken over a thirty (30) day period."

State or EPA water quality standards that relate to temperature are specific to coldwater biota, salmonid spawning and to bull trout include:

"Cold Water Biota: Stream temperature not to exceed 22° C (71.6 °F) with a maximum daily average no greater than 19° C (66.2° F).

Salmonid Spawning: Stream temperature not to exceed 13° C (55.4° F) with a maximum daily average no greater than 9° C (48.2° F) during identified spawning/incubation periods identified for species.

Bull Trout Waters: (State of Idaho) Known bull trout spawning and juvenile rearing stream segments: Stream temperature not to exceed 12° C (53.6° F) evaluated on seven-day moving average based on daily average water temperature, or shall not exceed a *seven-day moving average of 15° C (59.0° F) based on daily maximum water temperatures, during July, August and September. Bull trout spawning: Stream temperature not to exceed 9° C (48.2° F) from September 1 – April 1.*

Bull Trout Waters: (EPA) The EPA issued a site-specific temperature criterion for those waterbody segments in Idaho where bull trout spawn and juvenile bull trout rear (40 CFR 131.E.1.i.d (1997)). "This Rule establishes a maximum weekly maximum temperature (MWMT) criterion of 10° C (50.0° F) for the months of June, July, August and September for the protection of bull trout spawning and juvenile rearing in natal streams, expressed as an average of daily maximum temperatures over a consecutive 7-day period" EPA criterion specifically lists the Lemhi River, Hawley Creek and Mill Creek." Stream temperature standards are summarized in Table 2.2.1.

Antidegradation Policy

Idaho's Antidegradation Policy (IDAPA 16.01.02.051) states that "existing instream water uses and the level of water quality necessary to protect existing uses shall be maintained and protected." The policy makes provisions for degradation when "…necessary to accommodate important economic or social development in the area in which the waters are located," though water quality must continue to support beneficial uses.

Data Gaps

The most significant data gaps within the Lemhi TMDL are with regard to nutrient and bacteria loading on Lemhi River tributaries. The elevated levels of fecal coliform and nutrients within the Lemhi River, as indicated by monitoring data on the Lemhi River, indicate the potential for elevated loading of bacteria and nutrients from irrigation return waters and tributaries of the Lemhi River. Evaluation of bacteria and nutrient loading is needed on tributaries to further define the sources and seasonality of loading. Though ocular surveys of nuisance levels of aquatic plants and epiphytic algal growths may satisfy the current narrative water quality standard with regard to nutrients,
determination of nutrient loading to the Lemhi River from tributaries is important to identify sources of bacteria and is keeping with the designation of the Lemhi River as a Special Resource Water. Further defining bacterial loading to Lemhi River tributaries is also an important component of a holistic water quality management plan for the Lemhi River subbasin. Bacteria and nutrient monitoring will be needed to further define the application and effectiveness of BMP implementation within the Lemhi River subbasin.

Additionally, surface and subsurface sediment composition of the Lemhi River substrate should be evaluated as part of the follow-up monitoring of the TMDL and water quality management plan. Though beneficial uses directly effected by sedimentation appear to be fully supported within the Lemhi River, it is important to characterize the potential effect of sediment loading by Lemhi River tributaries for which TMDLs have been defined.

Ultimately, it may be possible to link beneficial use support for coldwater biota and salmonid spawning with narrative criteria and specification of a sediment load or load capacity with sediment targets set forth in this TMDL. The time period for establishment of this linkage cannot be determined in advance, and resources for this level of monitoring and BMP implementation have not been clearly identified at this time. Adaptive management becomes the keystone of establishing these relationships and the timeframe for achieving full support of impaired beneficial uses is impossible to specifically define, as required by TMDL criteria.

Table 2.2.1. Summary of current stream temperature water quality standards in Idaho.

Source of Standard	Beneficial Use	Instantaneous (not to exceed)	7 Day Sliding Average of Daily Average	Maximum Daily Average	7 Day Sliding Average of Daily Maximum
State of Idaho	Cold Water Biota	22°C 71.6°F	N/A	19°C 66.2°F	N/A
State of Idaho (seasonal by species)	Salmonid Spawning	13°C 55.4°F	N/A	9°C 48.2°F	N/A
State of Idaho July-September	Bull Trout Rearing	N/A	12°C 53.6°F	N/A	15°C 59.0°F
State of Idaho September1-April1	Bull Trout Spawning	9°C 48.2°F	N/A	N/A	N/A
EPA June, July, August, & September	Bull Trout Spawning and Rearing	N/A	N/A	N/A	10°C 50F

Target Selection

Sediment

Sediment target selection for the Lemhi River tributary TMDLs are based on instream surface and subsurface fine sediment. Surface fine sediment can be described by the particle size frequency distribution along a transect that extends across the bankfull channel of the stream or the wetted width of the stream. Bankfull channel surface fine sediment estimates record the distribution of particle sizes across the bankfull channel, which includes both submerged (instream) sediments, and dry bank deposits. Bankfull estimates of surface fine particle composition ten to be greater than instream or wetted width (submerged channel) estimates measured in riffles. The Lemhi River TMDL will incorporate instream surface fine sediment targets and it is important to distinguish between the two types of evaluations and their apparent effect on beneficial use support.

<u>*Development of surface fine sediment targets*</u>

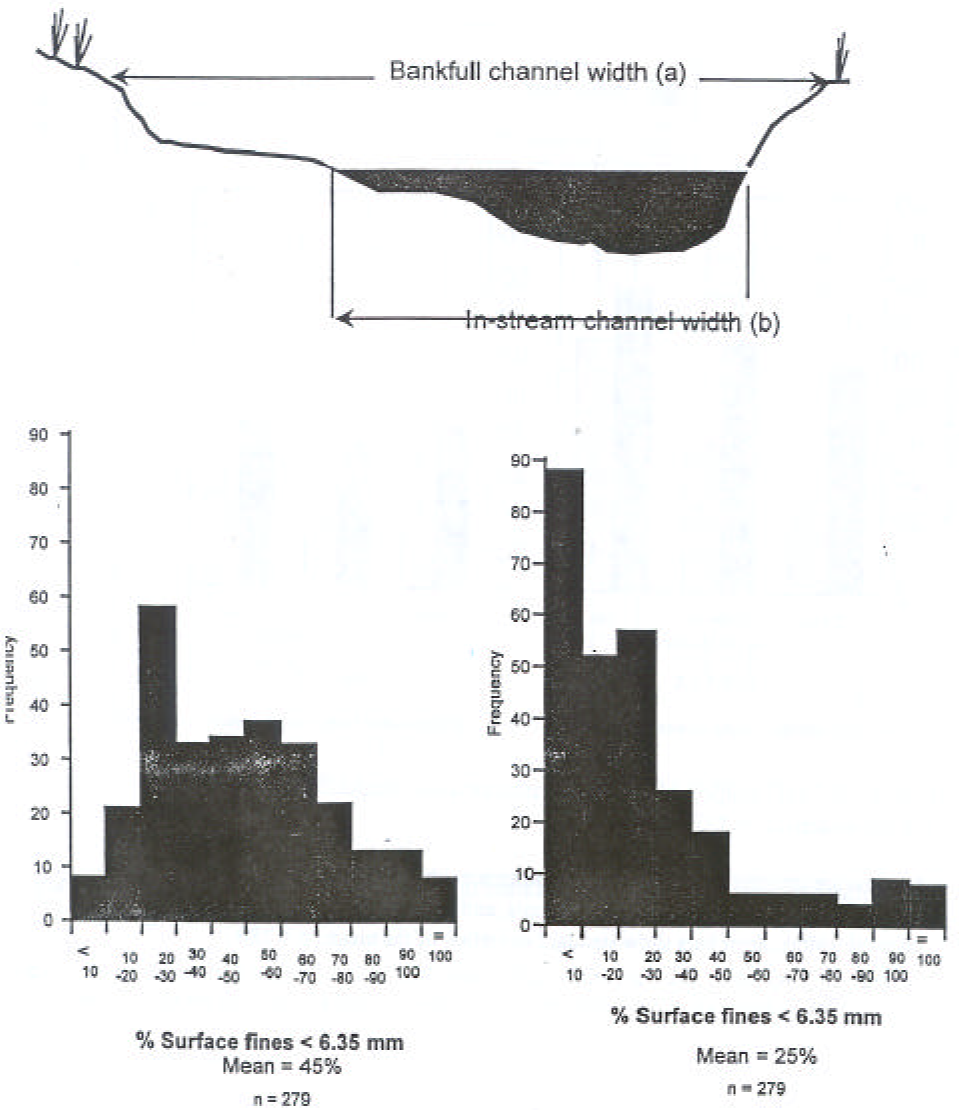
Mebane (*in review)* evaluated the relationship of bankfull surface fine sediment to instream fine sediment composition. Surface fine sediment data from 280 sites (3 transects per site) was collected during 1997 instream-biomonitoring in central and eastern Idaho. The sites represented both montane and valley streams, and a wide range of land uses, stream, and riparian conditions. The transects identified instream and bankfull pebble counts that characterized fine sediment composition (Figure 2.2.1). Bankfull pebble counts averaged 45%, with many streams having >50% fine sediments, while percentages of fine sediments measured by instream pebble counts of the same locations averaged 25% with few streams having >50% fine sediments. These differences have significant bearing on numerical target development. Because: (1) these large differences in the surface fines results from the two variations of the pebble count method; (2) both methods are in wide use with no consensus of which is preferable; and (3) agency and literature reports sometimes fail to specify which variation was used to derive their results, caution is advised when interpreting surface fines data or recommendations.

Macroinvertebrate assemblages showed measurable changes to percentages of fine grained surface sediments. Sites that were considered to have favorable macroinvertebrate assemblages (MBI scores greater than 3.5) averaged between 17-24% instream surface fine sediments, depending on stream gradient. These sites also averaged between 37-42% bankfull surface fines. Sites with MBI scores less than 3.5 averaged much higher percentages of surface fine sediments measured both across the instream or bankfull channel widths (Fig. 2.2.2 (a)).

Similarly to the macroinvertebrates, fish assemblage data and stream conditions in eastern and central Idaho were recently analyzed (Mebane *in review*). Of several fish metrics examined and environmental correlates examined, the analyses showed that the number of salmonid and sculpin age classes were strongly associated with percentages of surface fine sediments. Multiple age classes of both salmonids and sculpins were uncommon where average instream surface fines were greater than 30%, and nearly absent above 40% (75% and 90% of the sites with 3 or more age classes had less than 30% or 40% instream fine sediments respectively). Multiple age classes of sculpins were uncommon with average bankfull surface fines greater than 40%, and nearly absent above 60% (75% and 90% of the sites with 3 or more age classes had less than 30% or 40% *bankfull* fine sediments respectively). There was no statistically significant relationship between salmonid age classes and a percent surface fine measured over bankfull transects (Fig. 2.2.2 (b)). The salmonid and sculpin could not be analyzed with as many categories (different channel types) as were the macroinvertebrates because of the smaller fish data set. There were 68 fish sites with both instream and bankfull sediment data versus 280 macroinvertebrate sites (Mebane *in review*).

These biological apparent effects thresholds are similar to average natural conditions monitored in the Salmon River drainage. Overton et al. (1995) reported natural conditions for *instream* surface sediment varied from a mean of 25% in steep gradient reaches to a mean of 23% in moderate gradient reaches, to a mean of 34% in low gradient reaches (overall mean for all reaches equaled 26%).

Lemhi River Subbasin TMDL



(a) Percent fine grained sediments in the bankfull channel (bank deposits and submerged sediments). Mean = 45%

(b) Percent fine grained sediments (submerged sediments only). Mean = 25%

Figure 2.2.1. Relationship of (a) the bankfull width (bank deposits and instream sediments) and (b) instream fine sediment distributions at 280 sites.

Lemhi River Subbasin TMDL

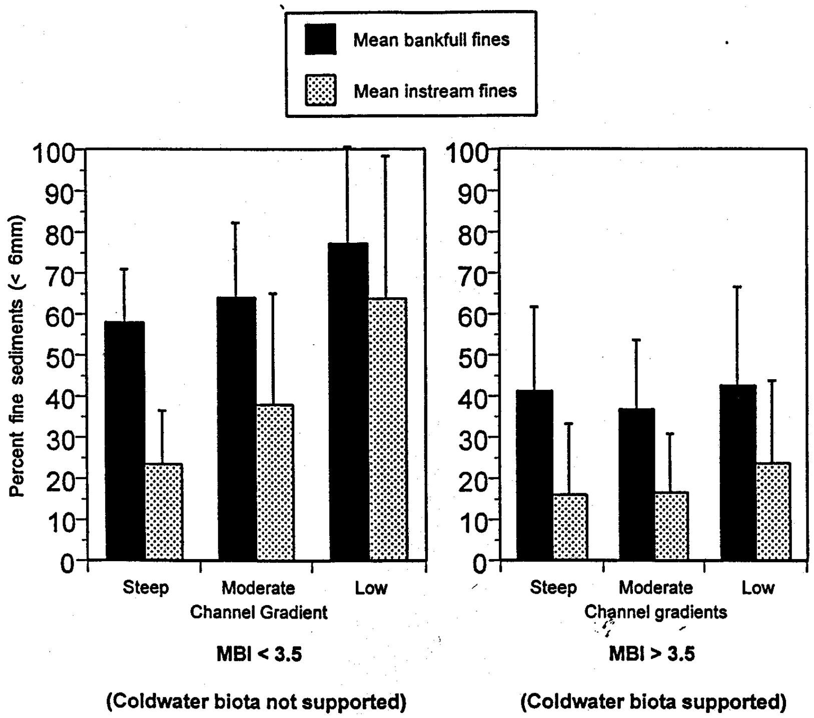


Figure 2.2.2 (a) Relationships of mean instream and bankfull fine surface sediment to MBI scores.

Streams are grouped by whether scores indicate coldwater biota is considered to be supported, stream gradients, and by wetted and bankfull channel widths. Error bars show standard deviation of the mean. n = 280

Lemhi River Subbasin TMDL

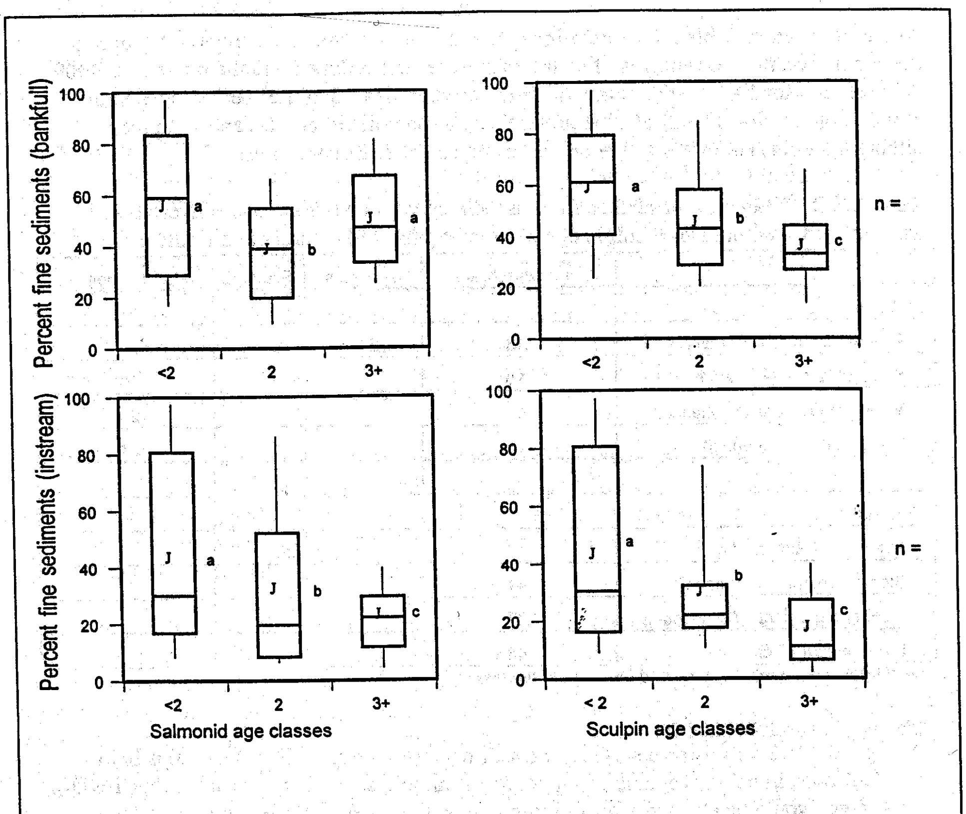


Figure 2.2.2 (b) Relationship of instream and bankfull fine surface sediment to salmonid and sculpin age class strength.

Boxes show interquartile ranges (25th to 75th percentile), whiskers show 10th-90th percentile ranges, the dot shows the mean. Letters indicate groups are statistically different at P< 0.05.

Redrawn from Mebane (*in review*).

As summarized in Table 2.2.2, these independent lines of evidence converge to support the conclusion that percentages of instream surface fine sediments in the range of 20-30% are preferred for fish and macroinvertebrate communities. Bankfull percentages in the range of up to 35-45% may also be preferable for macroinvertebrates and sculpins, although the lines of evidence are not as strong as with instream fines.

Table 2.2.2. Mean percent surface fines associated with favorable macroinvertebrate assemblages, salmonid and sculpin age class strengths, and natural conditions.

	Macroinvertebrates	Salmonids	Sculpins	Natural conditions
Instream				
Average (all channel types)	18	22	18	26
Steep gradient (A-channel)	16			25
Moderate gradient (B-channel)	17			23
Low gradient (C-channel)	24			34
Bankfull				
Average (all channel types)	40		38	
Steep gradient (A-channel)	41			
Moderate gradient (B-channel)	37			
Low gradient	43			

Data from Overton et al. (1995) and Mebane (*in review*)

Surface fine sediment target

A target of 20% for instream surface fine sediment >6.35 mm (0.25 in.) at riffles below pool tail-outs, in habitat capable of supporting salmonid spawning is used for this TMDL. This target would be attained after full implementation of BMPs identified to reduce surface and subsurface fine sediment. Instream surface and subsurface fine sediment will be monitored biannually beginning at completion of the initial implementation phase. By completion of the third biannual monitoring (6 years), after implementation, if targets do not exhibit an improving trend on sediment TMDL streams, additional BMPs will be evaluated for implementation to attain the target. If beneficial use support is determined to exist within the same monitoring period, targets will be re-evaluated.

This target incorporates an explicit margin of safety (approximately 20% below the mean value for instream surface fines identified by evaluation 280 sites and based on information from figure 2.2.2(a) and (b)). Instream fines appear to be more significant to salmonid species (figure 2.2.2(b)). In the future IDEQ BURP assessment will quantify instream fines within the bankfull measurement. This target is assumed to be adequate to improve the occurrence and distribution of multiple salmonid age classes present in streams within the Lemhi watershed for which sediment TMDLs are being developed and other water quality parameters are not limiting, such as flow or temperature.

Development of subsurface fine sediment targets

The percentage of subsurface fine sediment <6.35mm (0.25 in.) is felt to be a better indicator of the capability of spawning habitat to support self sustaining salmonid populations than surface fines (Robert Rose, USFS personal communication). The Salmon and Challis National Forest, in *The Forest Plan for the Salmon Zone* has an objective of 20% or less fine sediment <6.35 mm (0.25 in.) to 6 inches depth for streams supporting anadromous fish. In streams supporting only resident salmonid fish species, 28.7% fine sediment <6.35mm (0.25 in) to 4 inches depth is identified as the objective (Salmon National Forest 1988). This number reflects State of Idaho goals for fish production capabilities. Subsurface fine sediment standards are based on parent watershed geology. Quartzite streams in good condition have subsurface fine sediment <6.35mm (0.25 in.) (fines), at or below 20%, streams in fair condition have 20 to 25% fines, and streams in poor condition have fines greater than 25%. In granitic, volcanic and sedimentary drainages, streams in good, fair and poor condition will have <25%, 25-30%, and >30% subsurface fines, respectively.

Subsurface fine sediment is determined using the McNeil sediment core sampling technique. This sampling technique evaluates subsurface fines, to a depth of 4 in. for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fine sediment <6.35mm (0.25 in). The McNeil sediment core sampling methodology is described in Appendix A.

Chapman (1988) suggested that fine sediment <0.85 mm (0.03 in) is most responsible for suffocation and abrasion of salmonid eggs and coarser sediment, <9.5mm (0.37 in) can create a survival barrier preventing salmonid fry emergence from redd (Tappel and Bjornn 1983). Hall (1986) found survival (eyed egg to emergence) of coho, chinook and chum salmon to be only 7-10% in gravel mixtures made up of 10% fines as compared to 50- 75% survival in gravel mixtures with no fines <0.85mm (0.03 in). Reiser and White (1988) observed little survival of steelhead and Chinook salmon eggs beyond 10-20% fines <0.85mm (0.03 in). Though these additional sediment parameters affect fry survival, TMDL streams evaluated within the Lemhi River subbasin are generally below the limits identified above at this time. These parameters should continue to be evaluated as part of target monitoring to evaluate any potential shift in subsurface fine particle frequency distribution.

The subsurface fine sediment target for this TMDL is set at 28% or less fine particles <6.35mm (0.25 in) not including substrate larger than 63.5 mm (2.5 in) to be attained within 6 years after full implementation of BMPs identified to reduce surface and subsurface fine sediment. Surface and subsurface fine sediment will be monitored bi-annually beginning at completion of the initial implementation phase. By completion of the third monitoring phase, if targets are not met on sediment TMDL streams, additional BMPs will be identified to attain the target. If beneficial use support is determined to exist within the same monitoring period targets will be re-evaluated. Adaptive management of BMP implementation in relation to target monitoring results would be considered as a feedback loop.

Bacteria
Targets for fecal coliform bacteria within the Lemhi TMDL must ultimately reflect the water quality standards for both acute and chronic criteria (see Section 2.2 and 3.1).

Load capacity was considered for both Idaho's acute and chronic water quality criteria for fecal coliform. These criteria differ for the primary contact recreation season (May through September) and the secondary contact season (remainder of the year). Because of the apparent relation of bacterial concentrations to flow, load capacity was further examined under high and low flow conditions.

Depending on sampling site, reductions in loads necessary to meet the chronic criteria, on average, ranged from 17% to 63% during low flow, and 85% to 95% during high flow. When the data was broken down by year and flow regime, the necessary load reductions, to meet chronic criteria for all sampling dates, ranged from 77% to 90% during low flow, and 79% to 92% during high flow. The change is due to year-to-year variations in bacteria concentrations and above average summer flows over recent years.

There is a lack of understanding of sources of bacterial loading, instream viability of bacteria, and the high variation observed in bacteria concentrations and a corresponding low certainty in predicted concentrations under various flows. To account for this, an explicit 20% margin of safety in the target bacteria concentrations was added at the end of the analysis. This increased required load reductions to 82% to 92 % during low flow, and 83% to 94 % under high flow, depending up on sampling site. Reconnaissance sampling by the Idaho Department of Agriculture shows the potential relationship of likely sources and between fecal coliform and E-coli concentrations by potential source (Figure 2.2.3). The most significant potential sources identified in the reconnaissance sampling include irrigation drain return flow and Pasture outlet flow. Additional potential sources not monitored include residential septic system locations along the Lemhi River and it's tributaries. Implementation Plan monitoring, agreed to be conducted by the Idaho Soil Conservation Commission and the USDA NRCS in Salmon, Idaho at the September 8^{th} 1999 Salmon Basin Advisory Group meeting, in Salmon, will include identifying site specific sources along the Lemhi River and its tributaries over a three year period beginning in 2000. This comprehensive sampling will help identify effective types of BMPs and locations for BMPs to achieve necessary reduction in bacterial loads.

Lemhi River Subbasin TMDL

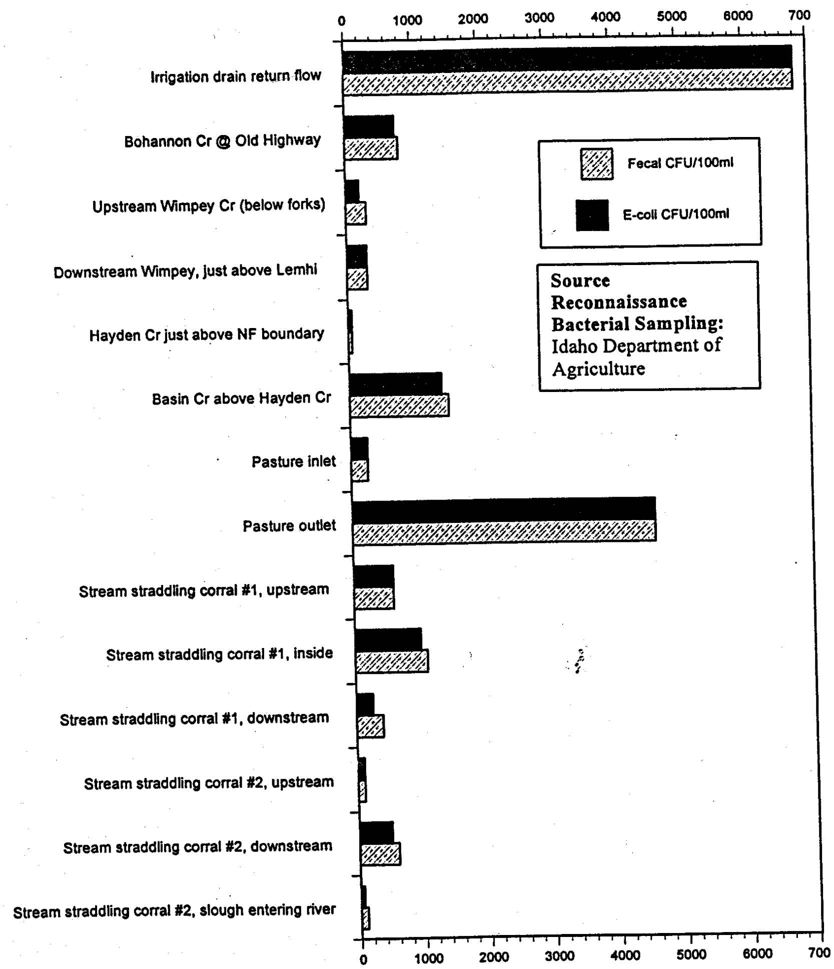


Figure 2.2.3. Comparison of potential sources of fecal coliform bacteria. Results of June 2, 1998 reconnaissance sampling by Idaho Department of Agriculture.

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3.0 Lemhi Subbasin TMDL

3.1 Lemhi River Bacteria TMDL

Watershed Description

The Lemhi River begins at the confluence of Texas Creek and Eighteenmile Creek near the town of Leadore, and flows northwest through the Lemhi Valley, ending one mile north of Salmon, Idaho, where the Lemhi River empties into the Salmon River at 4,000 feet elevation. The watershed encompasses approximately 812,796 acres of combined private, state, and federally managed lands. The Lemhi River watershed is bordered to the west by the Little Lost and Pahsimeroi drainages and to the east by the Medicine Lodge Creek drainage in Montana.

This TMDL addresses fecal coliform loading on the Lemhi River. The Lemhi River is on the 1998 proposed §303(d) list for fecal coliform from its source at the confluence of Texas and Eighteenmile Creek to its confluence with the Lemhi River. This listing definition encompasses the entire length of the Lemhi River. The primary land uses adjacent to the Lemhi River include residential development, irrigated agriculture, transportation, pasture, stock watering, recreation and commercial development.

Beneficial Use Support Status and Pollutants of Concern

The Lemhi River is on the 1998 proposed §303(d) list for bacteria over its entire length. Seasonally elevated levels of nitrogen and phosphorus have been noted through sampling, however, there are no indications of nuisance levels of aquatic plants or epiphytic algal growth that would impair beneficial uses. It is felt that BMPs that reduce bacteria levels in the Lemhi River subbasin will result in a corresponding decrease in nutrient loads.

Existing Conditions

Most monitoring on the mainstem Lemhi has focused on fish numbers, densities and habitat. Additional water temperature and water quality monitoring has been sporadic and limited in scope. The USGS began biological level sampling in 1998 and that data will be incorporated into subsequent implementation publications when it becomes available to DEQ. Specific results of water quality and vegetative monitoring are discussed in the individual watershed assessment portions of the Lemhi River Watershed and Subbasin Assessment (IDEQ 1998). Water quality monitoring was conducted by the IDEQ, through the BURP following the process identified in the 1996 Water Body Assessment Guidance (IDEQ 1996). Vegetative and riparian monitoring on federal lands has followed established agency monitoring protocols.

The IDEQ sampled water quality parameters at six sites on the Lemhi River. Sampling was conducted using the BURP protocols. The upper most BURP site is just below the Tyler Ranch between the confluence of Little Eightmile Creek and the village of Leadore (T16N R26E SW1/4 NE1/4 SE1/4 of Section 18 on the West of Leadore Quadrangle). The next downstream site is just below Little Eightmile Creek (T16N R25E SE1/4 SE1/4 SE1/4 of Section 3 on the West of Leadore Quadrangle). The next downstream site is just below the road crossing behind the

Lemhi Store (T18N R24E SE1/4 SE1/4 SW1/4 of Section 28 on the Lemhi Quadrangle). The next downstream site is just below the Barracks Lane Bridge (T21N R23E NW1/4 SE1/4 SE1/4 of Section 30 on the Sal Mountain Quadrangle). The next downstream site is approximately 5 miles above the mouth just below the L-4 diversion (T21N R22E NE1/4 NW1/4 NE1/4 of Section 14 on the East of Salmon Quadrangle). The most downstream sample site is just below the St. Charles Street Bridge (T21N R22E SE1/4 NW1/4 NW1/4 of Section 5 on the Salmon Quadrangle). Streambank erosion inventories were conducted in 1994 as part of a habitat assessment done by the Lemhi River Model Watershed Office. The Inventory was conducted on the upper, middle and lower Lemhi River as well as at Big Springs.

The streambank erosion inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation adapted by the USDA Natural Resources Conservation Service (NRCS) as a tool to evaluate erosion condition on stream banks, gullies and roads and has been widely applied in Eastern Idaho State Agriculture Water Quality Programs (Appendix A). In 1994 surveys were conducted along 4 sections of the Lemhi River. The total sediment yield from streambank erosion was estimated at 3,699 tons of sediment over the sample reaches. This compares with 1,692 tons of sediment yield from the Pahsimeroi River streambanks sampled, and 1,597 tons of sediment yield from the East Fork Salmon River streambanks sampled which are adjacent watersheds with similar land use, flow, morphology though less drainage area.

As part of BURP, macroinvertebrates (aquatic insects and other invertebrates that live in a stream) are collected and identified to Genus and when possible to species. Each type of macroinvertebrate is assigned a score based on its relative need for water quality or its tolerance for degraded water quality. The scores are accumulated into a macroinvertebrate biotic index score (MBI) (Appendix B). Aquatic insect communities sampled are listed from the upper most sample site to the lowest sample site described above and showed scores of 4.4, 4.2, 4.4, 3.9, 2.9 and 6.5 respectively. The low score of 2.9 occurs at the BURP site just below the L-4 irrigation diversion. Scores greater than 3.5 are considered to be non-impaired macroinvertebrate communities. These samples score high overall, due to the presence of macroinvertebrate species that generally thrive in high quality water and the lack of macroinvertebrate species that have a preference for degraded water quality.

Also a part of BURP, the habitat index gives a score based on the natural fish habitat conditions. All of the sample sites on the Lemhi River fall within the Snake River Basin/High Desert Ecoregion. From the upper most sample site sampled to the lowest site sampled the scores are 77, 91, 98, 104, 92 and 87 respectively. A score >88 is required to meet the necessary threshold to show non-impaired conditions.

Water Quality Concerns

Water quality of the Lemhi River and tributary streams in the subbasin varies with the time of year and the extent of human influence. All pollutants are from non-point sources, that is, there is no one single location or activity that can be identified as the single source of pollutants. Potential pollutants include sediment, bacteria, nutrients, and metals. Potential sources of these pollutants found within the watersheds include mine tailings, streambank modification and destabilization, timber harvesting, reforestation, improper residue management, irrigation runoff, rangeland (livestock grazing), flow regulation/modification, irrigation return water, highway/road/bridge construction and pastureland treatment. Generally, bacterial loading from non-point sources is the pollutant of concern. Potential sources include residential septic systems, wildlife, irrigated pasture, rangeland, upland pastureland, and irrigation return water. Although nutrients from rangeland, pastureland and cropland are also of concern (IDEQ 1988), there are no identified nuisance levels of aquatic plants or epiphytic algal growth noted in the Lemhi River. Cold water biota and salmonid spawning in many tributaries are potentially at risk from sedimentation, primarily from tributaries. Recreation activities that occur in and around water are also potentially at risk due to bacteria loading.

Lemhi River Fecal Coliform Loading Analysis

Data Used

<u>Fecal Coliform Data</u>
As of August 1998 209 water samples had been collected from six sites on the Lemhi River on 41 dates over the past four years. The samples were analyzed for fecal coliform and other parameters by the Bureau of Reclamation (BOR) laboratory in Boise (found in Appendix D). Other sites on tributaries were also sampled but were not used due to lack of corresponding flow data. Although sample collection continued, this analysis is based on those sample results that were available at the time the analysis began. Stream flows needed for calculating loads were not available at the sampling sites, and were thus estimated. Staff gauge data was not used because of the subjective nature of data recording and the inconsistent frequency with which the data is recorded.

Table 3.1.1 provides a breakdown of the sampling frequency by site and year. The sampling period and intensity has varied from year to year, and only 1995 provides comprehensive information about bacteria concentrations throughout the year. After 1995 sampling was concentrated during Idaho?s primary contact recreation (PCR) period of May 1 through Sept. 3. The numbers of samples collected during the PCR period are in parentheses. The data set analyzed is felt to be adequate to identify the necessary reductions in bacterial loading to meet the requirements of current water quality standards.

Table 3.1.1. Frequency by Year of Bureau of Reclamation Samples for Bacteria Analysis.

Station	1995	1996	1997	1998 [1]	Total
LMH109	12 (6)	8 (7)	10 (6)	11 (11)	41 (30)
LMH107	12 (6)	8 (7)	10 (6)	-- ---	30 (19)
LMH105	12 (6)	8 (7)	10 (6)	12 (12)	41 (31)
LMH103	12 (6)	8 (7)	10 (6)	12 (12)	41 (31)
LMH102	-- ---	-- ---	-- ---	12 (12)	12 (12)
LMH101	12 (6)	8 (7)	10 (6)	12 (12)	41 (31)
n for year	60 (30)	40 (35)	50 (30)	59 (59)	209 (154)

[1] data through 8-11-98, sampling ongoing numbers in parentheses represent samples collected May 1 to Sep 30, Idaho?s primary contact recreation period.

Fecal coliform geometric mean concentrations and the number of exceedances of Idaho?s acute (a.k.a. instantaneous) PCR criterion (not more than 500/100ml) are summarized in Table 3.1.2. Criteria exceedances are shown in boldface. Although data outside the PCR period are few, it can be seen that bacteria problems are confined to the PCR period. The data in Table 3.1.2 also indicate that chronic loading of bacteria is more of a problem than acute loading. Geometric means during the PCR exceed the chronic criterion of 50/100ml several times over in most cases, while exceedance of the acute criterion of 500/100ml are infrequent.

Table 3.1.2. Summary of Fecal Coliform Data.

Station		1995		1996		1997		1998 [1]	
		geomean	#>500	geomean	#>500	geomean	#>500	geomean	#>500
LMH 109	PCR	**300**	**1**	**347**	**2**	**241**	**1**	**327**	**2**
	sec	43	0	190	0	55	0	ns	?
LMH 107	PCR	**229**	**1**	**490**	**3**	**310**	**1**		na
	sec	24	0	74	0	21	0	na	na
LMH 105	PCR	**264**	**1**	**381**	**3**	**281**	**1**	**331**	**1**
	sec	10	0	180	0	52	0	ns	?
LMH 103	PCR	**120**	**1**	**172**	0	**132**	0	**193**	**1**
	sec	18	0	86	0	15	0	ns	?
LMH 102	PCR	ns	?	ns	?	ns	?	**280**	0
	sec	ns	?	ns	?	ns	?	ns	?
LMH 101	PCR	**133**	**1**	**80**	**1**	**271**	**1**	**332**	**3**
	sec	9	0	80	0	34	0	ns	?
Mean PCR flow[2]		470 cfs		285 cfs		429 cfs		526 cfs	

ns = not sampled, na = not available, PCR denotes primary contact recreation time period - May 1 to Sep 30
sec = the remainder of the year.
[1] data through 8-11-98. LMH107 sampled by USGS in 1998, these data were not available.

[2] May 1 through Sept 30; 90th %tile = 455, median = 287, 10th % tile = 121; 1998 incomplete; mean for May 1 through Aug 11.

The fecal coliform data are shown in Figure 3.1.1, illustrating the seasonal distribution of bacteria concentrations. The regular presence of spikes during high flow suggests high bacteria concentrations may be occurring whenever flow becomes high enough, though the data is not available to document it. In 1995 and again in 1997 exceedances of the 500/100ml criterion were limited to high flow during May and June.

This suggests that exceedances of the acute criterion may be predicted based on flow. It will be seen in the next section that there is a weak but significant correlation of fecal coliform concentrations with flow at three of the six sites. From Figure 3.1.1 it also appears that bacteria concentrations in general have not changed much over these four years. It does appear that peak concentrations were lower in 1998 than previous years, except at LMH101, which shows an atypical increase in late summer of that year.

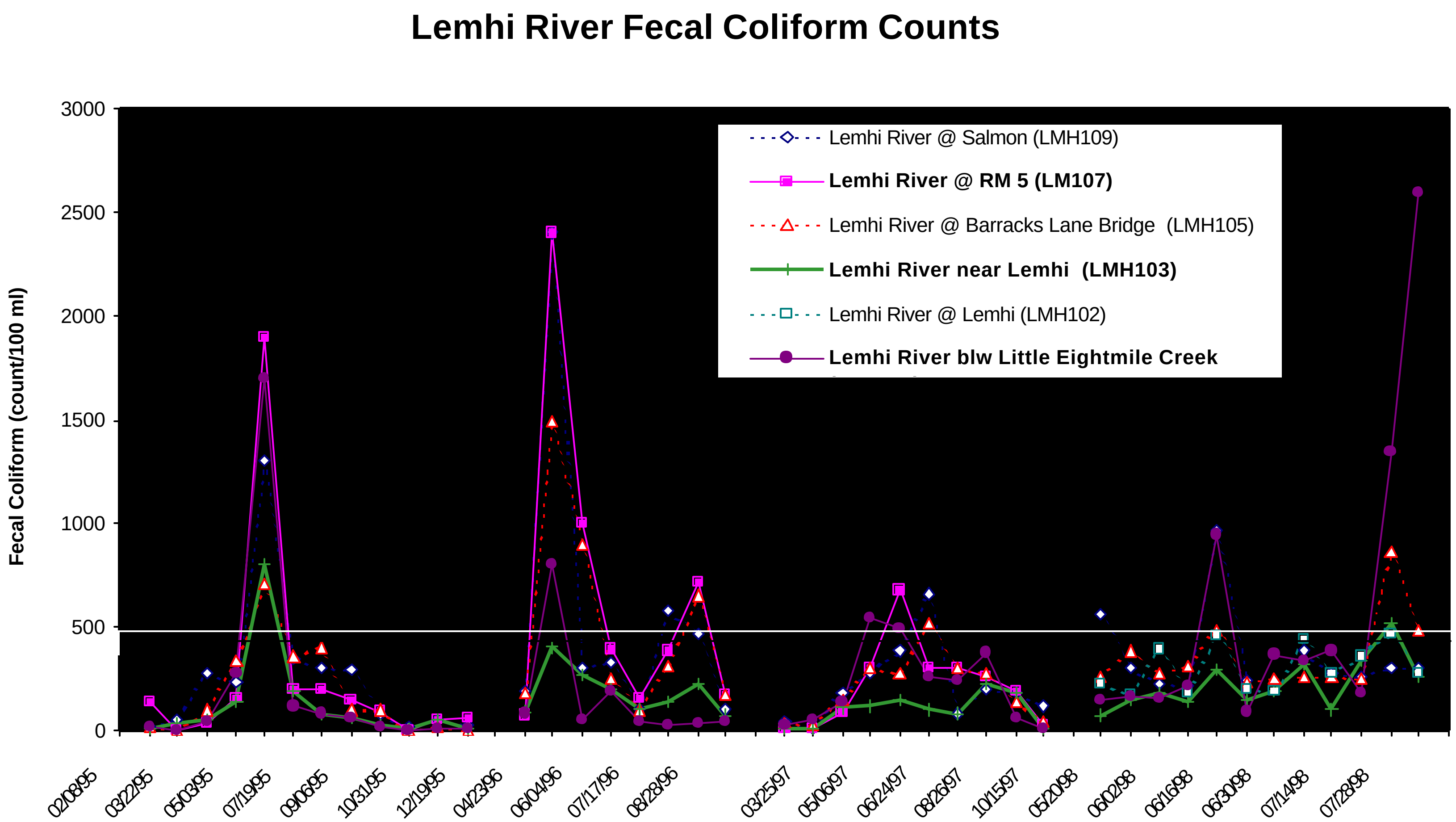


Figure 3.1.1. Time Series Plot of Fecal Coliform Counts in the Lemhi River from March 1995 through August 1998 at six locations.

Flow Data

This analysis relies on two active USGS gauging stations in the Lemhi subbasin - Lemhi River near Lemhi (13305000) and Lemhi R. Below L5 diversion (13305310) to estimate flows at the bacteria sampling sites where flow data was not available. The later gauging station has been in operation only since water year (WY) 1992, while the former has been in operation since 1939 and provides forty years of continuous daily discharge data.

Table 3.1.3 provides a list of the gauging stations and water quality sampling stations. Gauging station 13305310 corresponds in locations to water sampling site LMH107, and station 13305000 is a little down stream of LMH103. Drainage area of each sampling site and the lower

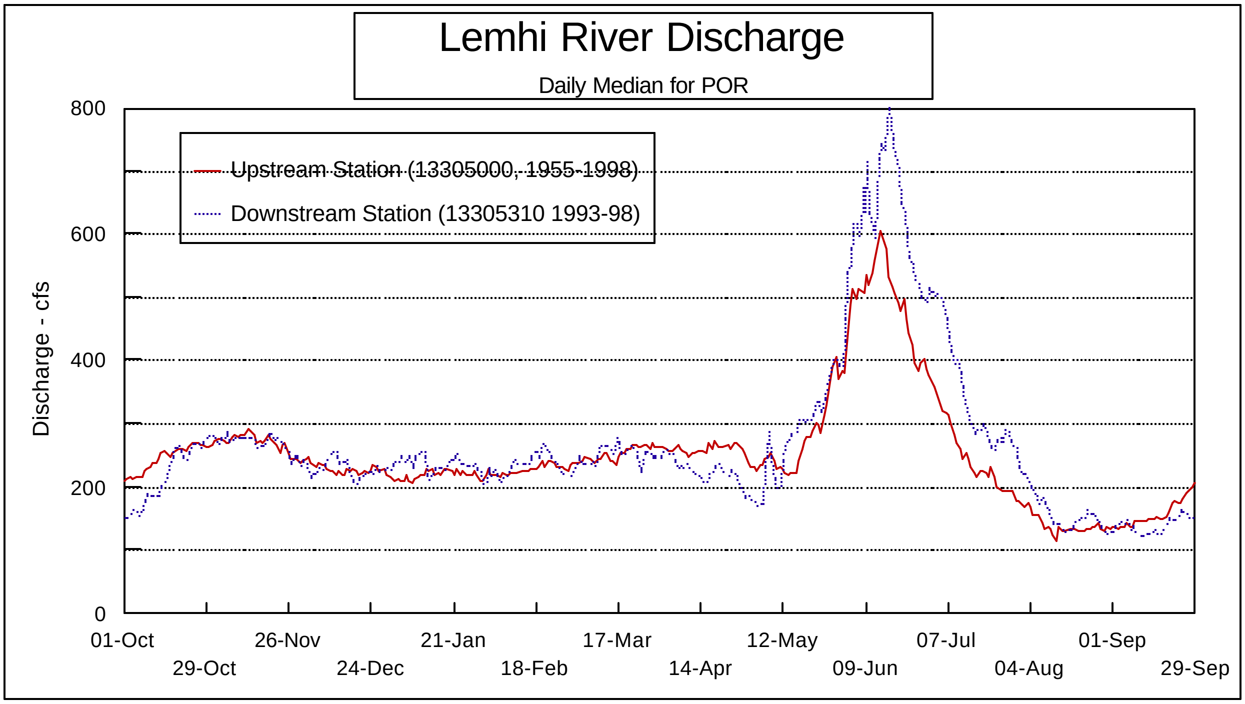
Table 3.13. Locations and Drainage Areas of Gauging Station and Sampling Sites.

Site	N Latitude	W Longitude	Drainage Area, sq mi	POR[1]
Lemhi River @ Salmon (LMH109)	45.1816	113.8883	1265	1995-98
Lemhi River blw L5 Diversion (USGS 13305310)	45.1322	113.7978	1218	1993-98
Lemhi River @ RM 5 (LMH107)	45.1322	113.7978	1218	1995-97
Lemhi River @ Barracks Lane Bridge (LMH105)	45.1153	113.7744	1192	1995-98
Lemhi River near Lemhi (USGS 13305000)	44.9400	113.6378	895	1939-98
Lemhi River near Lemhi (LMH103)	44.8905	113.6264	884	1995-98
Lemhi River @ Lemhi (LMH102)	44.8694	113.6256	735	1998
Lemhi River blw Little Eightmile Creek (LMH101)	44.7393	113.4623	575	1995-98

[1] Period of record, for USGS stations this is water years which begin Oct. 1 of the preceding calendar year.

gauging station (13305310) was determined using GIS (ArcView? 3.0a). Basic data included site coordinates (from Tom Herron IDEQ, Idaho Falls), fourth field hydrologic unit boundary, and DRG?s of USGS topographic maps. The drainage area for USGS station 13305000 is as reported in Brennen and others (1998).

Ratios of these drainage areas were used to estimate daily flows on the date of water sampling at each un-gauged sites (unit discharge approach). It is apparent that intervening diversions (particularly the L5) cause the downstream hydrograph (13305310) to differ in shape from that upstream (13305000), see Figure 3.1.2. For this reason flow at gauging station 13305310 (as extended) was used to estimate flow at sampling sites LMH09 and LMH07, and measured flow at



13305000 was used to estimate flow at the remaining sites.

Figure 3.1.2. Lemhi River Daily Median Discharge for Period of Record.

Design flow and critical loading conditions

Design flow is a concept typically applied to point source loading analysis (EPA 1991). The concept is based upon steady loading to receiving water whose load capacity is flow variable. Under such conditions the probability of exceeding water quality criteria depends entirely (or at least largely) on the probability of there being insufficient flow for adequate dilution, thus a minimum design flow at which the loading becomes critical can be set. Application of this concept to non-point sources is problematic.

For non-point sources loading typically is not steady, rather it tends to be related to the same processes which generate runoff. Thus definition of critical loading conditions, in terms of streamflow, is not so simple. Critical conditions may occur at high flow if there is a strong correlation between load and concentration. But critical conditions could occur at some intermediate flow, if load vs flow correlation is weak or variable. If sources are truly non-point, i.e. runoff driven, critical conditions are least likely to occur at low flow.

This is further complicated by the fact that incoming non-point source load is not measured, it can not be directly measured as it can for point sources. Instead the incoming load is usually inferred from measurements of instream concentration and flow. That is the approach used in this bacteria loading analysis. Instead of looking at loading directly, the relation between instream concentration and flow is used to inform us about critical loading. If the slope of concentration versus flow is positive, the probability of criteria exceedances increases with flow and critical loading occurs at some threshold of high flow. If the slope is negative the converse is true. If the correlation is variable, then more sophisticated analysis or graphical examination of the data may reveal something. If the correlation is weak or non-existent no definable critical loading period can be said to exist.

In the Lemhi River three of six sites have significant correlation between concentration and flow (Table 3.1.4). Slopes were positive for all three, but the highest R^2 is 0.329, thus at best only 33% of the variation in bacteria are explained by flow. When a relation exists between flow and instream concentration, it is useful for predicting concentrations at unmonitored flows, such as design flows. Even if the regression is weak (low R^2), if it is significant (F<.05) it leads to a better estimate of loading than simply using average concentrations.

Table 3.1.4. Results from Regression of Fecal Coliform Concentrations on Flow.

Station	**n**	**Adjusted R^2**	**Significance of Regression F**	**Intercept**	**Regression Slope**		
					Coef.	**L95%CL**	**U95%CL**
LMH109	41	0.047	0.092	212	0.248	-0.042	0.538
LMH107	30	**0.191**	**0.009**	109	0.609	0.164	1.053
LMH105	41	0.045	0.098	200	0.201	-0.039	0.441
LMH103	41	**0.329**	**<0.001**	34	0.322	0.179	0.466
LMH102	12	-0.093	0.801	323	-0.051	-0.495	0.392
LMH101	41	**0.111**	**0.019**	45	1.033	0.180	1.885

Derivation of Design flow

It was decided to use 10th and 90th percentile flows for critical loading ‘design’ purposes. This is based on EPA’s 305(b) reporting guidance (EPA 1997). Although that document does not specifically address bacteria, in the chapter on making use support determinations full support for conventional pollutants is defined as criteria exceeded in ? 10 percent of measurements. Assuming that critical loading occurs at either high or low flow, not both, a ten-percentile design flow equates to 10 percent of measurements exceeding criteria. The above regression analysis suggests high flows are more likely to be critical than low flows. A look at the time series of bacteria data (Figure 3.1.1) supports high flow as well. None-the-less, in the interest of thoroughness both low and high flow conditions are examined.

The 40 year flow record at 13305000 was used to calculate 10th and 90th percentile design flows for each day of the year. Because of a relatively short period of record, the values are quite variable from day to day and therefore a 15-day centered running average was used to smooth these values. Doing so avoids unrealistic jumps and dips in load capacity that is an artifact of noise in the data. The result is the pair of solid lines in Figure 3.1.3. Because the downstream gauging station’s period of record is only 6 years (1993-98) direct calculation of 10th and 90th percentile flow is appropriate. To overcome this limitation in the data average ratios of daily discharge values were calculated for both the active USGS stations for the common period of record (1993-98).

These average daily ratios were also smoothed. The smoothed daily ratios were used to estimate. 10th and 90th percentile values for the lower station by adjustment of the statistics calculated for the upper station. The result is the pair of dashed lines in Figure 3.1.3.

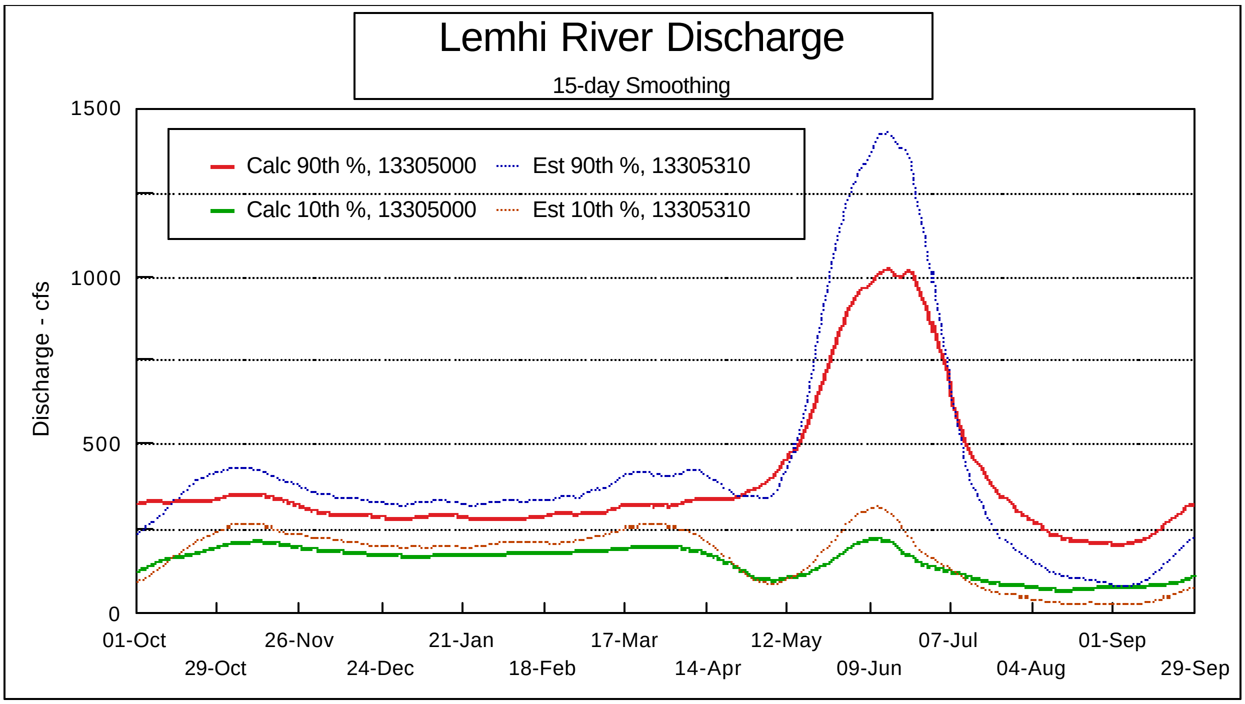


Figure 3.1.3**.** Lemhi River Calculated and Estimated 10th & 90th Percentile Flows.

By looking at these flow statistics on a daily basis seasonality in flow and thus loading capacity is accounted for. Basing load capacity on these flows means that for a given date 9 out of 10 years, on average, will meet water quality criteria.

Loading Analysis

In a conventional approach to TMDLs there are two basic steps to loading analysis, determining or predicting existing loads and determining the load capacity. The difference of the two provides the necessary load reductions that need to be achieved in order to meet water quality standards.

Simplifying Assumptions

When basing existing loads on instream measurements there is the possibility of underestimating loads to the waterbody. This is because of the assimilation or processing of pollutant loads that may take place between the point of entry to the water and the point it is measured. If this occurs the pollutant, in this case bacteria, is non-conservative, it can change in amount between source and point of measurement. Only part of the source load may be actually ‘seen’?in the measurement, thus the measured load can be thought of as the effective load. The idea of an effective load is particularly relevant to bacteria, which are living organisms subject to die-off once they leave their source.

Although the effective bacteria loads are likely a fraction of the actual loads this is not a serious limitation if the ratio is constant. It will be constant if we do not affect the assimilation of bacteria between source and measurement point by any source reduction activities. By assuming a constant ratio between instream and source loads we are saying that it is expected that measured bacteria concentrations will decline in proportion to source load reductions.

The ratio is not constant, and is likely greater for those bacteria sources closer to the drainage network. If we bear this in mind and prioritize control of bacteria sources accordingly we can end up with a TMDL that in application out performs our average predictions. In the end, the measure of our success in load reduction will be a measured decrease in instream bacteria concentrations at selected points on the Lemhi River.

Pollutant loads are typically expressed as mass per unit time, units such as tons per year or lbs per day. With such units a mass balance between instream and source loads can be used to make sure all sources are accounted for. Because bacteria are an organism, each with its own mass, standard mass balance is not strictly applicable. However, if we assume bacteria populations are characterized by an average mass per individual, numbers of bacteria become a substitute for their mass. Furthermore, if what were are really concerned about is numbers of organisms regardless of size, then a numbers balance is just as useful as a mass balance.

Finally, the analysis makes the common assumption that a single instantaneous sample represents the mean daily concentration of bacteria in the river.

Summary of Approach Used

Five steps lead to final estimated load reductions needed for fecal coliform in the Lemhi River. These steps consist of 1) calculation of existing daily loads; 2) calculation of daily load capacities and comparison to existing loads; 3) evaluation of critical loading conditions and initial daily load reductions; 4) a look at chronic loading and reevaluation of load reductions; 5) statement of margins of safety. The analysis considers seasonality by looking at day to day loading, high and low flow periods. It further considers year to year variations, and both instantaneous and geometric mean criteria. Primary Contact versus Secondary Contact recreation periods were considered above in evaluating water quality condition. A margin of safety is addressed through choice of conservative conditions during loading analysis as well as an explicit additional margin at the end.

Load Calculation Formula

All fecal coliform loads are expressed in counts (# of colony forming units or cfu) per day using the formula below. Substituting 1 for both the bacteria concentration and flow gives the conversion factor of ***0.02445*** for converting the product of concentration in cfu/100ml and flow in cfs to cfu/day.

cfu/100ml x cu ft/sec x 10*(100ml)/liter x 28.3l/cu ft x 60sec/min x 60min/hr x 24hr/day = *0.02445* cfu/day

Because of the large volumes of water involved the values are well over a billion per day, so all values were divided by 10^9 to express loads in billions of cfu per day.

cfu/day / 10^9 = billions of cfu/day

Load Capacities and Targets

Existing Load Calculation

Table 3.1.5 provides a summary of the measured and estimated existing daily loads. Measured fecal coliform loads are highly dynamic, ranging over two orders of magnitude. Estimates were calculated only for dates of sampling in order to allow comparison to measured load calculations. Estimated maximum loads do not reach the observed maximums, and the geometric mean of estimated high flow load is about twice that observed. This can be attributed to the low regression R^2 values, such that in the Lemhi a simple flow related prediction poorly accounts for the highly dynamic nature of bacteria concentrations. Water temperature is a possibly important co-variate not taken into account due to time constraints.

Table 3.1.5. Existing Fecal Coliform Daily Loads During PCR Period, 10^9 cfu/day[1].

Site	Measured			Low Flow Estimates[2]			High Flow Estimates		
	Min	Geomean	Max	Min	Geomean	Max	Min	Geomean	Max
LMH109	230	2400	63000	?	?	?	?	?	?
LMH107	270	1800	88000	98	460	2300	320	4000	34000
LMH105	490	3600	35000	?	?	?	?	?	?
LMH103	160	1300	30000	95	210	570	520	2200	9200
LMH102	1400	2800	6900	?	?	?	?	?	?
LMH101	47	1100	41000	100	230	690	620	2800	12000

[1] Values rounded to 2 significant figures.
[2] Estimates for same dates as actual measurements to allow comparison.

Daily Load Capacity

Daily load capacities were initially calculated from both the 10th percentile low flow, and 90th percentile high flow, on the dates of sampling and using the 500 cfu/100ml fecal coliform acute criterion. The seasonal range in fecal coliform daily load capacities is summarized in Table 3.1.6. The decrease in minimum capacity downstream of Barracks Lane Bridge (LMH105) is due to the timing of diversions that exert their influence later in the summer when stream flows are lower.

Table 3.1.6. Range of Fecal Coliform Daily Load Capacity During PCR Period, 10^9 cfu/day[1].

Site	10th% Flow		90th % Flow	
	Min	Max	Min	Max
LMH109	380	4000	1000	18000
LMH107	370	3800	980	17000
LMH105	1100	3700	3500	17000
LMH103	860	2800	2600	12000
LMH102	840	2700	2100	10000
LMH101	700	2300	1700	8000

[1] Values rounded to 2 significant figures.

Comparison of these load capacities to measured loads showed severe over-prediction of exceedances based when low flow load capacity was used, and reasonable agreement with observed exceedances when high flow capacity was used. Measured loads exceed the calculated low flow capacity on 96 out of 209 days sampled, while there were but 25 observed exceedances. On two days with observed exceedance, the calculated low flow load capacity was greater than the measured load.

Measured loads exceeded high flow capacity only 26 times. Matching much better with observed frequency of criteria exceedances, and seventy-two percent (18 of 25) actual acute criteria violations match with measured loads greater than the calculated high flow capacity.

This reinforces the conclusion, from regression analysis and graphical examination of the data, that low flow is not a critical time for acute criteria exceedances. Rather high flows are more typically the critical loading time for acute criteria violations, i.e. for fecal coliform in the Lemhi River daily loading is mostly an issue at high flow.

Critical loading period and daily load reduction

Using the regressions presented earlier, the flow at each site at which 500 cfu/100ml bacteria would be reached, on average, is estimated. Loads corresponding to these threshold flows are given in Table 3.1.7. By comparing the threshold flow to 90th percentile daily mean flow at a station a period when high flows become critical is defined. Load reductions necessary to meet the acute criterion were calculated from the ratio of the load for the highest 90th percentile flow within this period and the threshold load. At only two of three sites is high flow loading found to be a problem more than 1 year in 10 for any date within the PCR period (see Table 3.1.7).

Using the load capacity at the threshold flow, rather than the load capacity on the day of peak flow, is a conservative step. This is because load capacity is flow dependent and within critical high flow period is almost always greater than the threshold flow. As a result only at peak flow is it expected that as much as 1 in 10 years will see an acute criteria violation, the rest of the time the expected frequency of exceedances will be even less.

Table 3.1.7. Fecal Coliform Critical Daily Load Capacity During PCR Period, 10^9 cfu/day[1].

Site	Critical Cond.		Estimated Peak Load	When is critical load exceeded (90th %tile flow > critical flow)	Load reduction needed[2]
	Flow	Load			
LMH107	1259	15000	**34000**	more than 10% of years from 3-Jun - 24-Jun	**55%**
LMH103	1447	18000	9200	less than 10% of years for all dates	none
LMH101	440	5400	**12000**	more than 10% of years from 23-May -5-Jul	**54%**

[1] Loads rounded to 2 significant figures, flow in cfs.
[2] Based on bringing load calculated for peak 90th % flow down to critical load, calculated from un-rounded loads.

These load reductions should bring the Lemhi River in compliance with the 500 cfu/100ml fecal coliform criterion 90% of years on the worst day in a year, and more than 90% of the years on other days. But, are these reductions in load enough to meet the geometric mean criterion of 50 cfu/100ml? Is more or less load reduction needed to meet the chronic criterion?

Chronic Load Capacity

Idaho has a geometric mean fecal coliform criterion, which is considered a chronic criterion. Idaho?s PCR criteria states that fecal coliform shall not exceed 50 cfu/100ml for a geometric mean based on a minimum of five samples in any 30 day period. For a chronic criterion the concept of a maximum daily load breaks down. Usually the chronic criterion is applied as if it were daily criteria for TMDL purposes. Thus, if the bacteria levels were steady they could reach 50 cfu/100ml every day and just meet the chronic criteria. Incidentally, constraining load analysis to a steady concentration requires the greatest % reduction for a given load. A steady daily concentration of 50 cfu/100ml forms the basis for Lemhi River chronic load capacity.

Although the frequency of the data collected (less than five time per 30 days) does not allow strict evaluation of Idaho?s chronic criterion, it is assumed that the dates sampled are representative of a range of flow conditions and concentrations. Under this assumption the geometric mean based on the existing data is similar to that expected from more frequent samples. Only dates sampled are used in the following calculations and chronic fecal coliform loads are evaluated as a geometric mean loads over an entire flow period.

The high flow period used was 23-May to 5-July, as determined above for acute loading and coinciding with the average runoff peak. Within this period the 90th percentile flow for each date was used. The low flow period was taken to be the months of August and September, when summer flows are observed to reach a minimum. Within this period the 10th percentile flow for each date was used.

A geometric mean of predicted (flow dependent) concentrations was calculated across all years for both high flow and low flow periods. Corresponding geometric mean load capacities (daily design flow x 50 cfu/100ml) and existing loads (daily design flow x regression estimated concentration) were then calculated. These results are summarized in Table 3.1.8, for low flow conditions, and Table 3.1.9, for high flow conditions.

Table 3.1.8. Chronic Loading Summary, For August-September at 10th %-tile Low Flow.

Site	**Load[1] Capacity** (geomean)	**Estimated Load** (geomean)	**Estimated PCR Fecal Coliform Conc.** (geomean)	**Load reduction needed**
LMH107	49	132	**134**	**73%**
LMH103	98	117	**60**	**17%**
LMH101	64	126	**99**	**49%**

[1] Loads in 10^9 cfu/day, effective delivery.

Table 3.1.9. Chronic Loading Summary, For 23-May to 5-July at 90th %-tile High Flow.

Site	**Load[1] Capacity** (geomean)	**Estimated Load** (geomean)	**Estimated PCR Fecal Coliform Conc.** (geomean)	**Load reduction needed**
LMH107	1520	27100	**894**	**94%**
LMH103	1130	7450	**331**	**85%**
LMH101	732	9730	**664**	**92%**

[1] Loads in 10^9 cfu/day, effective delivery.

Comparing results in Table 3.1.8 to Table 3.1.9 shows greater load reductions needed at high flow than at low flow. It is also evident that meeting the chronic bacteria criterion requires substantially greater load reduction than meeting the acute criterion.

As a check the above specified reductions were applied to the set of observed data. This check takes into account observed temporal variability and the three sites for which regressions were not useful. Only chronic load reduction factors were used since they are greater than the acute reductions. Meeting the chronic criterion will result in the Lemhi River meeting both chronic and acute criteria.

Table 3.1.10 summarizes these load reductions and the effect they would have had on exceedances of the geometric mean criterion in the existing data. As expected, these reductions did not eliminate all chronic criteria exceedances in the sample data set. This is attributed to the high spatial and temporal variability in measured fecal coliform levels hard to capture in an analysis using a purely statistical approach (regression analysis, geometric means, 10th & 90th percentile flows).

To compensate the reductions were adjusted using a spreadsheet until the geometric mean criterion was met at all six sites, during both flow periods, and for all years. These adjusted load reductions are also presented in Table 3.1.10. The differences between high and low flow reductions largely disappear and are insignificant.

Table 3.1.10. Initial and Adjusted Load Reduction Percentages, by Season of Flow.

Initial Loading Reductions (LR)						
Site = LMH	109	107	105	103	102	101
High Flow LR	94%	94%	85%	85%	92%	92%
Low Flow LR	63%	63%	17%	17%	49%	49%
years when geo-mean >50 cfu/100ml	1 of 4	0 of 3	0 of 4	0 of 4	0 of 1	2 of 4
Adjusted Reductions [1]						
Site = LMH	109	107	105	103	102	101
High Flow LR	90%	92%	90%	79%	84%	86%
Low Flow LR	86%	90%	89%	77%	85%	90%

[1] Adjusted in the spreadsheet to just meet chronic criterion at all sites for past four years. These adjusted reductions are a unique solution, other combinations of increasing or decreasing high or low flow reductions are possible but will not differ greatly from the above.

Margin of Safety

A margin of safety (MOS) is built into this analysis by using a 90th or 10th percentile flows, applying the chronic criterion as a steady daily limit, and by further increasing the reductions to make that criteria would be met for all sites and dates actually sampled. An additional 20% explicit MOS is added (by targeting a geometric mean fecal coliform of 40 cfu/100ml) to address lack of understanding of bacterial sources and their population dynamics in the Lemhi subbasin. The further load reductions this requires are small in comparison to the large reductions required without this extra MOS. The resulting final load reduction percentages, by site and flow season (high and low) are in Table 3.1.11.

Table 3.1.11. Final Load Reduction Percentages with explicit 20% MOS.

Site = LMH	109	107	105	103	102	101
High Flow LR	92%	94%	92%	83%	87%	89%
Low Flow LR	89%	92%	91%	82%	88%	92%

In the final analysis, load reductions were based on iterative spreadsheet scenarios. Earlier steps in the analysis served primarily to focus the analysis on high flows as critical, define the critical high flow period, and determine that meeting chronic criteria will be more difficult than meeting acute criteria.

3.2 Bohannon Creek Sediment TMDL

Watershed Description

The Bohannon Creek watershed is located approximately nine miles east of Salmon, Idaho. The watershed encompasses 14,117 acres of combined private, state, and federally managed lands (Table 3.2.1). The drainage is bordered to the west by the Geertson Creek drainage and to the east by the Wimpey Creek drainage. As with the other drainages in the Lemhi River Watershed, the USFS administers the lands at higher elevations and the lower portions of the watershed are under private ownership. The BLM administers the land that lies between the USFS and private property.

Table 3.2.1. Land ownership within the Bohannon Creek Watershed.

Bohannon Creek	**Total**	**BLM**	**USFS**	**State**	**Private**
Watershed Acres	14,117	7,036	2,269	666	4,146
Mainstem Stream Miles	9.7	1.8	1.1	0.7	6.1
Watershed Stream Miles	14.7	4.8	2.3	0.7	6.9
Percent Watershed Acres	100%	49.8%	16.1%	4.7%	29.4%
Percent Watershed Stream Miles	100%	35.9%	18.3%	2.7%	43.1%

The effects of dredge mining have irreversibly altered large portions of the valley bottom. The signs of this activity are visible throughout the lower portions of the watershed (Appendix E). Several large slides are visible on the east side of Bohannon Creek, the result of ditch failures during historic times when miners attempted to bring water to downstream sites to use in hydraulic mining operations.

The elevation of the watershed varies from 10,362 feet on Center Mountain along the Continental Divide to approximately 4,300 feet where Bohannon Creek joins the Lemhi River. The watershed is extremely steep in the higher elevations, with 35-50% of the watershed comprised of slopes in excess of 40%. The lower private lands are flatter, forming terraces and foothills that eventually drop into the Lemhi River bottom. Table 3.2.2 summarizes the watershed geomorphic characteristics.

This TMDL addresses sediment loading on Bohannon Creek. Bohannon Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses approximately the lower half of the creek. The primary land use adjacent to the §303(d) listed segment is grazing with irrigated agriculture.

Table 3.2.2. Bohannon Creek watershed geomorphic characteristics.

drainage area (square miles)	22.1
drainage density	0.7
maximum elevation (ft)	10,362
minimum elevation (ft)	4,300
relief ratio	0.118
sediment transport potential	0.3
total road length (miles)	27.38
road density (miles/square mile)	1.2

Beneficial Use Support Status and Pollutants of Concern

Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.

The listed reach on Bohannon Creek has been determined to Need Verification to show full support of salmonid spawning and coldwater biota beneficial uses. Sediment deposition as evidenced by percent subsurface fines exceeds desired values and conditions.

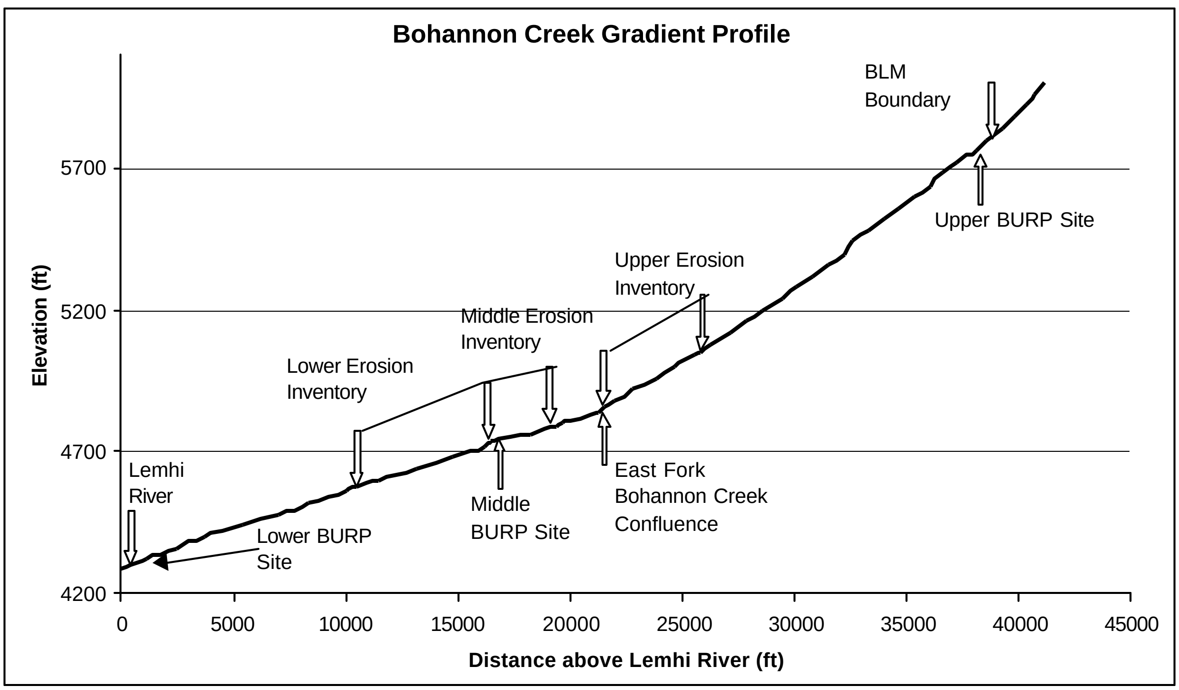


Figure 3.2.1 Bohannon Creek gradient profile with associated sample sites and boundaries (vertical exaggeration 12:1).

Existing Conditions

The baseflow for Bohannon Creek is currently unknown. The instream flow of Bohannon Creek at the USFS/BLM boundary in September of 1994 was too low to measure. In 1977, the instream flow was measured at 3.4 cubic feet per second, however the exact date of the measurement is not known, it may not be at base flow. The creek does not reach the Lemhi River due to multiple irrigation diversions that dewater it. The Bohannon Creek watershed has 13 diversion sites, all of which are unscreened. These diversions limit the amount of water in the creek, enough to prevent the creek from draining into the Lemhi River. There are 25 water rights claims on the creek, totaling 40.82 cfs for the period March 15 to November 15. Where the main fork of Bohannon Creek crosses BLM administered land the stream has a gradient of 8-12%. Channel type depends primarily on gradient, with A channels in the upper portions and B channels downstream. The stream has a dense tree/shrub overstory in some places, however, grazing to the edge of the stream has altered much of the riparian habitat along the stream. The upper segment of Bohannon Creek riparian habitat has been removed to accommodate irrigated agricultural production. Adjacent to this area is where historic placer mining has occurred. Neither the BLM nor the USFS have any established riparian monitoring sites within the watershed, due to the limited riparian habitat issues on the lands they manage.

The IDEQ sampled water quality parameters at three sites on Bohannon Creek. Sampling was conducted using the BURP protocols. The upper most site is approximately 300 m below the BLM boundary (T22N R23E NE1/4 SW1/4 SE1/4 of Section 35 on the Bohannon Spring Quadrangle). The next site downstream is approximately 100 m above the West Fork Wimpey Creek BLM road (T21N R23E SW1/4 SE1/4 SE1/4 of Section 15 on the Bohannon Spring Quadrangle). The lowest BURP site sampled is approximately 10 m above the old highway (T21N R23E SW1/4 SE1/4 SW1/4 of Section 28 on the Baker Quadrangle). McNeil sediment core samples, nutrient and thermograph data were collected approximately 200 m below the West Fork Wimpey Creek Road. Erosion inventory Estimates were conducted on four reaches with one reach above the confluence of the East Fork of Bohannon Creek, one reach slightly overlapping the confluence of the East Fork and two reaches below the confluence of the East Fork of Bohannon Creek.

Sediment analysis included a McNeil Core sample and Wolman pebble counts at BURP sites. The McNeil sampling data evaluates subsurface fines to a depth of 4 in for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fines less than 0.25 in (6.35 mm). The mean % fines including substrate 2.5 in (63.5 mm) and greater was 27.8%, with a standard deviation of 1.8. The mean % fines not including substrate 2.5 in (63.5 mm) and greater, was 36.6%, with a standard deviation of 4.6.

Wolman pebble counts show 19% of surface particles less than 0.25 in (6.35mm) diameter at the upper and middle BURP sites and 15% at the lowest site. The mean % fines less than 0.85 mm (0.03 in) including substrate 2.5 in (63.5 mm) and greater was 5.6%. The mean % fines less than 0.85 mm (0.03 in) not including substrate 2.5 in (63.5 mm) and greater was 7.5%.

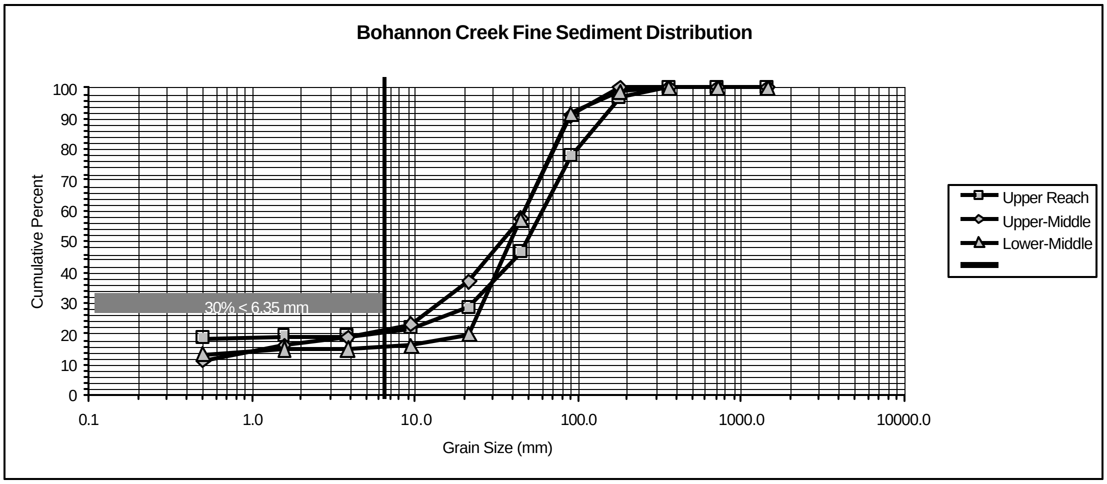


Figure 3.2.2 Surface fine sediment composition associated with BURP sites.

The streambank erosion inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation developed by the NRCS as a tool to evaluate erosion condition on streambanks, gullies and roads (Appendix A). In 1997, a survey was conducted on four reaches on private lands along 47% (3.2 miles) of the listed reach length. Streambanks along the upper mainstem reach were classified as having very severe erosion potential, with an overall rating of 15 out of a potential 15. A lateral recession rate of 0.5 feet per year was determined, resulting in an estimated sediment yield of 290 tons per year for this reach and a corresponding estimate of 112 tons per mile per year of sediment from stream bank erosion over the sample reach. This ranks 5th out of 28 sample reaches surveyed on 13 streams in the Lemhi watershed. The average estimate of tons of sediment contributed by stream bank erosion per mile for all stream sample sections was 60 tons per mile per year. Of the total mainstem stream miles of Bohannon Creek this sample section is likely representative of approximately 3 miles of stream.

Streambanks along the middle mainstem reach (from the mainstem/East Fork confluence downstream) were classified as having moderate erosion potential, with an overall rating of 6 out of a potential 15. A lateral recession rate of 0.1 feet per year was determined, resulting in an estimated sediment yield of 91 tons per year for this reach and a corresponding estimate of 94 tons per mile of sediment from streambank erosion over the sample reach. This ranks 6th out of the 28 sample reaches. This sample section is likely representative of its actual length.

Streambanks along the lower mainstem reach (going downstream from the West Fork Wimpey Creek Road) were classified as having severe erosion potential, with an overall rating of 8 out of a potential 15. A lateral recession rate of 0.2 feet per year was determined, resulting in an estimated sediment yield of 158 tons per year for this reach and a corresponding estimate of 90 tons per mile per year of sediment from stream bank erosion over the sample reach. This inventory segment ranks 7th out of 28 sample reaches surveyed on 13 streams in the Lemhi watershed.

Streambanks along a reach of the East Fork of Wimpey Creek were classified as having a slight erosion potential, with an overall rating of 4 out of a potential 15. A lateral recession rate of 0.05 feet per year was determined, resulting in an estimated sediment yield of 47 tons per year for this reach and a corresponding estimate of 27 tons per mile per year of sediment from stream bank erosion over the sample reach. This ranks 14th out of 28 sample reaches surveyed on 13 streams in the Lemhi watershed. This sample section is likely representative of approximately 2.5 miles of the East Fork of Bohannon Creek below its canyon mouth.

Aquatic insect communities sampled at the upper, middle and lower sites showed scores of 5.1, 4.8 and 4.1, respectively. Scores greater than 3.5 are indicative of non-impaired macroinvertebrate communities. The samples score high due to the presence of macroinvertebrate species, which show a preference for high water quality.

The HI gives a score based on the natural fish habitat conditions. The upper site falls within the Northern Rockies Ecoregion, and the score of 89 fails to meet the non-impaired threshold of 99, and falls into the needs verification category (IDEQ 1996). Both the middle and lower sites fall within the Snake River Basin/High Desert Ecoregion. The score of 98 at the middle BURP site meets the required threshold of 88, indicating non-impaired conditions. The score of 69 at the lower site fails to meet the necessary threshold, and like the upper site, falls into the needs verification category.

Nutrient grab samples were collected approximately 200 m below the West Fork Wimpey Creek Road in August 1997. Sampling shows a total nitrogen value of 0.128 mg/l, and a total phosphorus value of <0.05 mg/l. The total nitrogen result does not exceed the concentration recommended by Golterman (1975) of 0.3 mg/l. The result for total phosphorus falls below the EPA suggested threshold of 0.1 mg/l (EPA 1986). The state water quality nutrient standards are narrative and require waters to be free from nuisance levels of aquatic plants and algae. Nuisance levels of aquatic plants were not noted in BURP survey or erosion inventory records. Algae were not observed in excessive quantities at any of the BURP or erosion inventory evaluation sites. Further investigation would be required to quantify the overall impact of nutrient loading in Bohannon Creek.

IDEQ measured water temperature approximately 200 m downstream from the West Fork Wimpey Creek Road (Appendix C). Temperature recording was initiated on July 1, 1997 and terminated on October 30, 1997. Temperature readings were collected each hour during this period. Maximum daily average water temperature was 57.1° F (13.9° C, with a maximum seven-day average of daily maximum of 62.7° F (17.05° C). Water temperature within Bohannon Creek violates State water temperature standards for salmonid spawning with regard to instantaneous daily maximum temperature from July 3rd through August 1st with daily maximum temperatures in excess of 55.4° F (13° C). Due to degraded riparian habitat conditions, Bohannon Creek would be at risk of increased stream temperature if continued riparian degradation were to occur in combination with reduced flow from irrigation diversion.

Fish were sampled by electrofishing by IDEQ over a 100 m transect in one pass beginning approximately 100 m above the West Fork Wimpey Creek rd on July 30th, 1997. The sampling day was the second day of a 3-day cooling trend for stream temperature with temperatures ranging from 51° F (10.5° C) to 62° F (16.6° C). Three rainbow trout were collected in two age classes along with three sculpin. No juvenile or young of the year salmonids were collected.

Water Quality Concerns

Bohannon Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses approximately the lower half of the creek. The primary land use adjacent to the §303(d) listed segment is grazing and irrigated agriculture with stock watering. Land ownership along the listed segment is private with associated water rights. Stream temperature is within State water quality standards for coldwater biota and salmonid spawning. The condition of riparian habitat and streambank stability is poor to fair over much of the listed reach, however the upper and lower erosion inventory segments exhibit streambank erosion that is likely impacting the stream.

The primary water quality concern is related to subsurface fine sediment deposited within the stream substrate. Subsurface fine sediment is above desirable levels. There is not recent fish sampling data to show full support for salmonid spawning in Bohannon Creek and it is likely that there is a relationship between elevated subsurface fine sediment composition of the substrate and success of spawning fish. Contributing factors could be unscreened irrigation diversions and reduced stream flows that limit the ability of the stream to move fine sediment. It is also possible that other habitat components important to rearing fish are reduced or absent over the listed reach.

Rainbow and westslope cutthroat trout are documented as present in Bohannon Creek. Westslope cutthroat trout have been petitioned for listing under the Endangered Species Act. It is evident that there is successful spawning activity occurring in the Bohannon Creek watershed. This is shown by the presence of salmonids, particularly cutthroat trout, despite the lack of connectivity with the Lemhi River. There is no documentation of present or historical planting of salmonids in the Bohannon Creek watershed. Salmonid spawning is likely fully supported above the BLM boundary, as evidenced by the presence of native salmonids, but could be extended below the BLM boundary with a reduction in subsurface fine sediment. This would reduce the increased risks of effect to the fish population from catastrophic natural events, which is elevated by the lack of connectivity with the Lemhi River.

Applicable Criteria

Idaho water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states, "*Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses...*" In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state, "*Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.*"

Load Capacities and Targets

The current state of the science does not allow specification of a sediment or nutrient load or load capacity that is known in advance to meet the narrative criteria for sediment and to fully support beneficial uses for coldwater biota and salmonid spawning. All that can be said is that the load capacity lies somewhere between the current loading and natural background levels. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for Bohannon Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment targets and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. Existing sediment sources are identified and the opportunity exists through implementation of BMPs to gain significant reductions in sediment load. Often nutrients adsorbed to sediment are reduced along with sediment reduction and as sediment sources are controlled it is likely that the potential for visible levels of slime growths or other undesirable aquatic plant growth would decline.

Sediment Targets

To improve the quality of spawning substrate and rearing habitat in Bohannon Creek, it is necessary to reduce the component of subsurface fines of 6.35 mm and less to below 28 %. It is also recommended that instream surface fine sediment deposition in spawning habitat not increase above 20 %. Current instream surface fine sediment composition should be maintained at or below observed levels. A detailed discussion of subsurface fines target selection is given under Target Identification in section 2.2.

Loading Summary

Existing Sediment Sources
The Bohannon Creek watershed has 27.4 miles of roads, of which 4.6 miles (16.7%) are improved gravel, 10.6 miles (38.8%) are unimproved and 12.2 miles (44.9%) are two-tracks. Road densities have been calculated at 1.24 miles per square mile.

The BLM's PACFISH Road Maintenance Plan identified the West Fork Wimpey Creek road as a Moderate sediment producer. The West Fork Wimpey Creek Road, a BLM maintained road, is a spur off the Bohannon Creek road. The source of most sediment is water running down the steeper grades and into an intermittent draw and then into Bohannon Creek. The road has been water-barred to slow the velocity of water running off the road, but erosion still occurs. The West Fork Wimpey Creek Road and an associated four wheel drive trail are adjacent to Wimpey Creek or the Sawmill Gulch Spring (generally within 75 m) for approximately 2.8 miles. Additionally, there is a four wheel drive trail adjacent to the East Fork of Bohannon Creek. This four wheel drive trail is generally within 50 m of the East Fork of Bohannon over 1.6 miles from the West Fork Wimpey Creek Road to the end of the trail and is also an eroding road surface without cross drains or out-sloping BMPs to reduce erosion. There is a four wheel drive trail along Bohannon Creek that begins from the Bohannon Creek Road on private land. This trail is within the riparian corridor from the BLM boundary to where it ends, 1.4 miles above the BLM boundary. Due to the close proximity of these roads to surface water it is assumed that they are hydrologically connected and that the sediment produced is ultimately transported to Bohannon Creek. The amount of traffic on the four wheel drive trails is assumed to be light, due to the rough nature of the roads, however, sediment continues to be produced in the absence of traffic.

Riparian habitat condition has been evaluated on 9.7 miles of Bohannon Creek of which 1.4 miles of riparian habitat on BLM land and 1.1 miles on USFS land were assessed as Proper Functioning Condition. Riparian habitat rated as Functional At Risk with a static trend included 0.3 miles of BLM and 0.7 miles of State land. Private land assessed in the Functional At Risk category had a downward trend over 3.7 miles. Non-Functional segments were 0.1 mile on BLM and 2.3 miles on Private land.

Riparian habitat condition has been evaluated on 5.0 miles of the East Fork of Bohannon Creek of which 1.9 miles on BLM land and 1.2 miles on USFS land and 0.8 miles on private land were assessed as Proper Functioning Condition. Riparian habitat rated as Functional At Risk with a static trend was 1.1 mile on BLM land. None of the East Fork of Bohannon Creek was rated as Non-Functional.

The streambank erosion inventory conducted on Bohannon Creek shows that the primary source of sediment from streambank erosion occurs over the upper evaluation reach. The middle and lower erosion inventory reaches and the East Fork of Bohannon Creek also produce significant amounts of sediment from streambank erosion however.

Estimates of existing Sediment Load

The East Fork of Bohannon Creek four wheel drive trail is generally within 50 m of the stream over approximately 50% of the 1.6 miles from the West Fork Wimpey Creek Road to the end of the trail with the remaining 50% within 25 m of the stream. Sediment production over this trail is estimated at 22.4 tons contributed to the East Fork. Additionally, the model was applied to the four wheel drive trail along Bohannon Creek from the BLM boundary to where it ends, 1.4 miles above the BLM boundary. The stream along this reach is about 50% within 25 m and 50% within 50 m. Sediment production along the Bohannon Creek four wheel drive trail is estimated to be 38.9 tons per year. The West Fork Wimpey Creek Road and the associated four wheel drive trail that extends up Sawmill Spring Gulch (and the associated spring) is approximately 75% within 25 m of the stream or spring with the remainder within 50 m. Due to the close proximity of these roads to surface water it is assumed that they are hydrologically connected and that the sediment produced is ultimately transported to Bohannon Creek.

Based on results from streambank erosion inventories on Bohannon Creek, the existing erosion rate ranges from 90 to 112 tons per mile per year. When the erosion rate is extrapolated to similar stream channel conditions it is estimated that Bohannon Creek receives 290 tons per year adjacent to the upper erosion inventory reach, 91 tons adjacent to the middle reach and 158 tons adjacent to the lower reach. The East Fork of Bohannon Creek erosion rate is estimated at 27 tons per mile per year and 47 tons per year overall.

Load Allocations

Using the water quality targets introduced above, sediment load allocations or sediment reductions are outlined in this section. Because the chronic sources of sediment are bank and road surface erosion, quantitative allocations are developed. These sediment load reductions are designed to meet the established water quality targets (20% instream surface fines and less than 28% depth fines). Bank erosion reductions are quantitatively linked to tons of sediment per year. An inferential link is developed to show how sediment load allocations will reduce subsurface fines. This link assumes that by reducing chronic sources of sediment, there will be a decrease in surface and subsurface fines ultimately improving the status of beneficial uses. Streambank erosion load allocations are based upon the assumption that natural background sediment production from streambanks equates to 80% streambank stability as described in Overton et al. (1995), where stable banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability potential is generally at 80% stability or greater for A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types.

Table 3.2.3 shows Bohannon Creek streambank and road erosion load allocations. Based on existing sediment load from bank erosion on the East Fork of Bohannon Creek, a reduction of 58 percent is recommended. A bank erosion reduction of 95 percent, 80 percent and 88 percent is recommended on the upper, middle and lower reaches of main Bohannon Creek respectively. Based on existing sediment load from road surface erosion on the West Fork Wimpey Creek Road a 53 percent reduction is recommended.

Table 3.2 .3. Bohannon Creek bank and road erosion load allocations.

Reach	**Existing bank erosion**		**Desired bank erosion**		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
East Fork	27	47	12	20	58
Upper	112	290	6	15	95
Middle	94	91	18	18	80
Lower	90	158	10	18	88
W.Fk. Rd/Trial	25	51	12	24	53
E.Fk. Trail	23	22	11	10	55
Bohannon Trail	38	39	19	19	51

Road surface erosion reductions of 55 and 51 percent are recommended for the four-wheel drive trails along upper Bohannon and the East Fork of Wimpey Creek respectively.

Margin of Safety

The MOS factored in for Bohannon Creek load allocations is implicit. The MOS are the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include: 1) Desired bank erosion rates are representative of background conditions; 2) Cumulatively, the assumptions used in the WEPP model are conservative; and 3) Water quality targets with regard to surface and depth fine sediment are consistent with values measured and set by local land management agencies based on established literature values and incorporate an adequate level of fry survival to provide for stable salmonid production.

Seasonal Variation and Critical Time Periods of Sediment Loading

To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed.

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage, most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example streambank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

3.3 Eighteenmile Creek Sediment TMDL

Watershed Description

The Eighteenmile Creek watershed, located approximately 55 miles southeast of Salmon, Idaho, is one of the largest watersheds in the Lemhi River watershed encompassing approximately 95,000 acres of combined private, state and federally managed lands (Table 3.3.1). The Eighteenmile Creek watershed forms the eastern half of the two most upstream watersheds, the western half being Texas Creek, which eventually form the Lemhi River near the town of Leadore. The Eighteenmile Creek watershed is unique within the Lemhi sub-basin in that it contains a portion of the Eighteenmile Wilderness Study Area (WSA). Eighteenmile Creek drains this 14,796 acre WSA.

Table 3.3.1. Land ownership within the Eighteenmile Creek watershed.

Eighteenmile Creek	Total	BLM	USFS	State	Private
Watershed Acres	94,940	68,607	8,004	4,485	13,843
Mainstem Stream Miles	28.0	10.2	0.0	2.3	17.5
Watershed Stream Miles	78.2	47.5	3.2	6.3	21.2
Percent Watershed Acres	100%	72.3%	8.4%	4.7%	14.6%
Percent Watershed Stream Miles	100%	60.7%	4.1%	8.1%	27.1%

The topography of the area varies from level or gently rolling fan terraces at an elevation of 5,972 feet near the town of Leadore, to the rugged foothills leading to the Continental Divide of the Beaverhead Mountain Range. Eighteenmile Peak dominates the uppermost portion of the watershed with its 11,257 foot elevation. Over 30% of the watershed have slopes in excess of 40% gradient. Table 3.3.2 summarizes the watershed geomorphic characteristics for Eighteenmile Creek.

Table 3.3.2. Eighteenmile Creek watershed geomorphic characteristics.

drainage area (square miles)	218
drainage density	0.4
maximum elevation (ft)	11,257
minimum elevation (ft)	5,972
relief ratio	0.031
sediment deposition ratio	0.10
sediment transport potential	0.10
total road length (miles)	211
road density (miles/square mile)	1

This TMDL addresses sediment loading on Eighteenmile Creek, which is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses the entire length of Eighteenmile Creek from the headwaters. The primary land use adjacent to the §303(d) listed segment is grazing with irrigated agriculture. Approximately 54 % of the mainstem stream miles are on private property while 46 % flows across BLM land and state land.

Beneficial Use Support Status and Pollutants of Concern
Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.

The listed reach on Eighteenmile Creek has been determined to Need Verification to show full support of Salmonid Spawning and Coldwater Biota beneficial uses. Sediment deposition as evidenced by percent surface and subsurface fine particle composition exceeds desired values and conditions. Figure 3.3.1 shows the gradient profile and sampling locations.

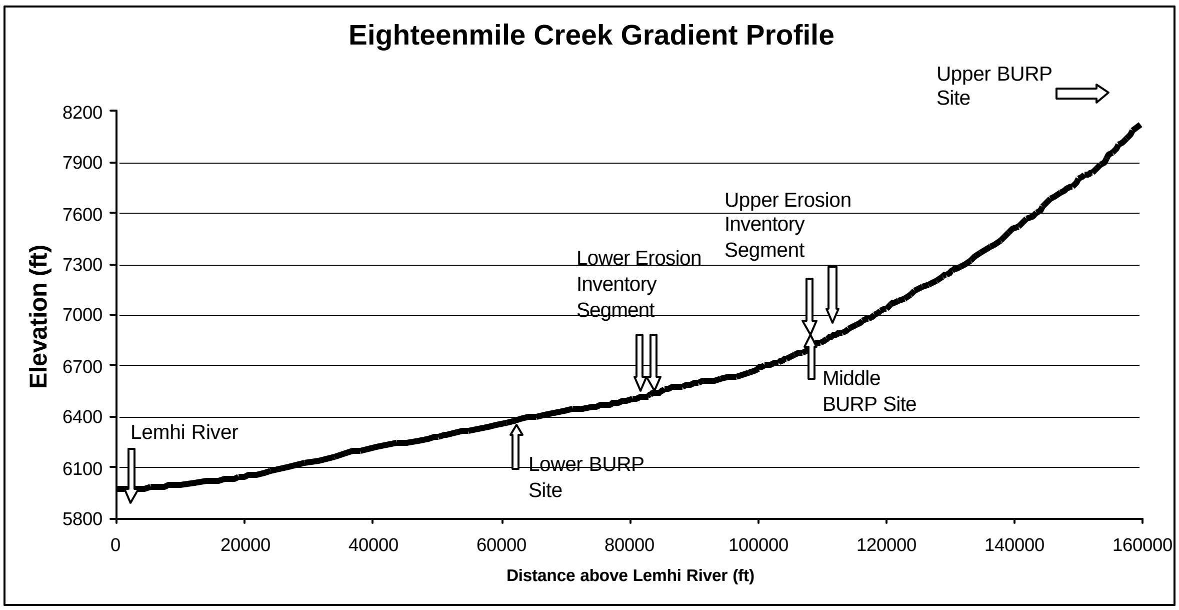


Figure 3.3.1. Eighteenmile Creek gradient profile with associated sample sites and boundaries (vertical exaggeration 33:1).

Existing Conditions
Groundwater influence is very important to Eighteenmile Creek as the watershed contains many springs, seeps, and small bogs. Also, snowfields and additional small watersheds contribute water. Eighteenmile Creek has a mainstem base flow of 5-10 cfs, depending on diversions, and is characterized by stream gradients varying from less than 1% in the B and C channels through the lower elevations and flats, to over 5% in the A and B channels higher near the headwaters. The watershed has several perennial streams including Hawley, Pass, Clear, Divide, Ten Mile, Bull, Poison, and McGinty Creeks. Of these, only Hawley, Pass and Divide Creeks appear to have historically ever reached Eighteenmile Creek, the others sank into the porous, alluvial substrate.

Currently, Hawley, Pass and Divide Creeks are largely dewatered from irrigation and infiltration and only reach Eighteenmile Creek for short duration during extremely high flows. Eighteenmile Creek is dewatered from diversion, generally year-round, beginning on the Ellsworth Angus Ranch, near Leadore, with no true channel ever reaching the Lemhi River. Ditches off Eighteenmile Creek connect with the ditch channel of lower Hawley Creek, and the water is transported in several ditches until a point downstream of the old railroad grade, where the ditch again takes on the appearance of a meandering channel, though not natural. This channel crosses Highway 29 through a culvert, east of where subsurface flows from Texas Creek and Eighteenmile/Hawley Creek form the Lemhi River in a large wetland complex. The majority of the Hawley Creek/Eighteenmile Creek water stays in a lateral ditch on the east side of the river. This ditch also picks up water from Canyon Creek, and continues down the valley to a confluence with Canyon Creek.

Hawley Creek, the largest of the tributaries, is completely diverted before it reaches the old Eighteenmile Creek channel. Pass Creek, a small, spring-fed tributary, is diverted into an irrigation ditch, which starts in Eighteenmile Creek. Clear Creek, inside the WSA, starts as a series of springs and seasonal snowfields in a large basin before descending into a narrow canyon. After exiting the canyon, the creek passes through a gypsum mine and is then completely diverted into an irrigation ditch. Tenmile Creek is similar in appearance to the Clear Creek sub-watershed. The upper mile of this stream is on USFS land. Irrigation ditches are used primarily from April 1 through October 31, but water is generally contained within them year-round. Due to the alluvial soils which increase infiltration, and lack of apparent channels, it is thought that Tenmile, Clear and Bull Creeks have never reached Eighteenmile Creek over the surface.

The condition of the riparian zone on Eighteenmile Creek varies throughout the watershed due to the effects of grazing, historic mining, and road building. Overall, it is generally in good condition, where not affected by water removal for irrigation purposes. Riparian conditions on private lands are generally in more degraded condition than on public lands. Where streams are seasonally dewatered, the typical riparian vegetation no longer exists. The willow community dominates the woody species, however, with few other species present. Aspen are present in the middle to upper portions of the watershed, especially around springs and seeps.

Visually, the riparian areas on private lands along upper Eighteenmile Creek appear to be functioning properly, with dense willow complexes, beaver ponds and braided channels. The middle reaches, on private and State ground, in particular, have been much more impacted by livestock grazing. Woody regeneration is limited and bank stability is poor. The BLM has fenced the longer reaches of public lands, allowing them to recover. The lower reaches, particularly those downstream of where the Eighteenmile Creek Road leaves the Oxbow Ranch Road, have been much more impacted by livestock grazing and irrigation practices. Through much of this section, irrigation practices have eliminated the stream channel, converting the fertile bottomlands to hay production and pastureland. Where subsurface water returns, particularly downstream of the old railroad grade in wetland complexes, willows and sedges become apparent once again, but livestock grazing has limited their numbers. This area is extremely hummocked, due to overgrazing, further drying out the soil and limiting the riparian vegetation.

The BLM has three riparian monitoring sites in this watershed located along Eighteenmile Creek. Two are located in the Eighteenmile Creek pasture of the Chamberlain Creek allotment and one is located in the Eighteenmile Flat pasture of the Powderhorn allotment. These sites are used for evaluation of grazing systems and to assist in determining interactions between wildlife and livestock. Photographs are the main method used along with stubble heights and greenline transect.

Nine upland monitoring plots are established in the Center Ridge allotment. These were established to determine the effectiveness of the grazing system designed in the allotment management plan. They include permanent line transects and photopoints to evaluate vegetation condition and trend. One upland nested frequency plot exists in the Lower Big Bend pasture of the Chamberlain Creek allotment and two nested frequency plots exist in the Powderhorn allotment in the Ten Mile and Eighteenmile Flat pastures. These plots also help in evaluating long term vegetation condition and trend.

In 1993 and 1994 low level (1:4,800 scale) color infra red photographs were taken of all streams within the Eighteenmile Creek watershed. These photographs are used as baseline inventory data for riparian areas and will be reflown in approximately ten years to determine changes to riparian area width and length and width of the wetted area along each stream.

The IDEQ has sampled water quality parameters at three sites on Eighteenmile Creek using the BURP protocols. The upper most site is 3.4 miles below the source (TN R29E SW 1/4 NW1/4 NW1/4 of Section 12 on the Cottonwood Creek Quadrangle). The next site downstream is approximately 2 miles above the confluence of Divide Creek (T14N R27E SW 1/4 SW 1/4 NW 1/4 of Section 36) on the Powderhorn Gulch Quadrangle. The next downstream site is approximately 3.5 miles below the confluence with Divide Creek on state land (T14N R27E SW 1/4 SE 1/4 NW 1/4 of Section 16 on the Powderhorn Gulch Quadrangle). This site was not sampled due to the presence of beaver dams. The lowest site sampled is above the Clear Creek Road culvert (T14N R27E NW 1/4 NW 1/4 SE 1/4 of Section 5 on the Purcell Spring Quadrangle).

McNeil sediment core samples were collected at the BURP site two miles above Divide Creek. Streambank erosion inventory estimates were conducted at two sites on Eighteenmile Creek. The upper inventory site was on 1.3 miles of Eighteen Mile Creek terminating at the BURP site 2 miles above Divide Creek (where McNeil sediment core sample were also taken) below state land. The lower inventory site was on 1.6 miles of Eighteenmile Creek starting at the BURP site 3.5 miles below Divide Creek. A temperature recording thermograph was placed at the third downstream BURP site from July 1st to October 30th, 1997. Nutrient samples were collected at the lowest BURP site above the culvert on Clear Creek Road, using an integrated depth sampler. Samples were evaluated for phosphorus and nitrogen.

Sediment analysis includes Wolman Pebble Count, McNeil Core Sampling, and a Bank Erosion Inventory. The Wolman Pebble Count is an evaluation of surface substrate particle size. Three sites were evaluated for % surface fines on Eighteenmile Creek in 1994, 1995 and 1997. The uppermost BURP site showed a Wolman Pebble Count of 38% less than 0.25 in (6.35 mm). The site above Divide Creek was 57% and the most downstream site sampled on Eighteenmile Creek was 46% (Figure 3.3.2). The data at these sites indicate a likely reduction in fry survival based on professional judgements and comparison to the McNeil sampling data.

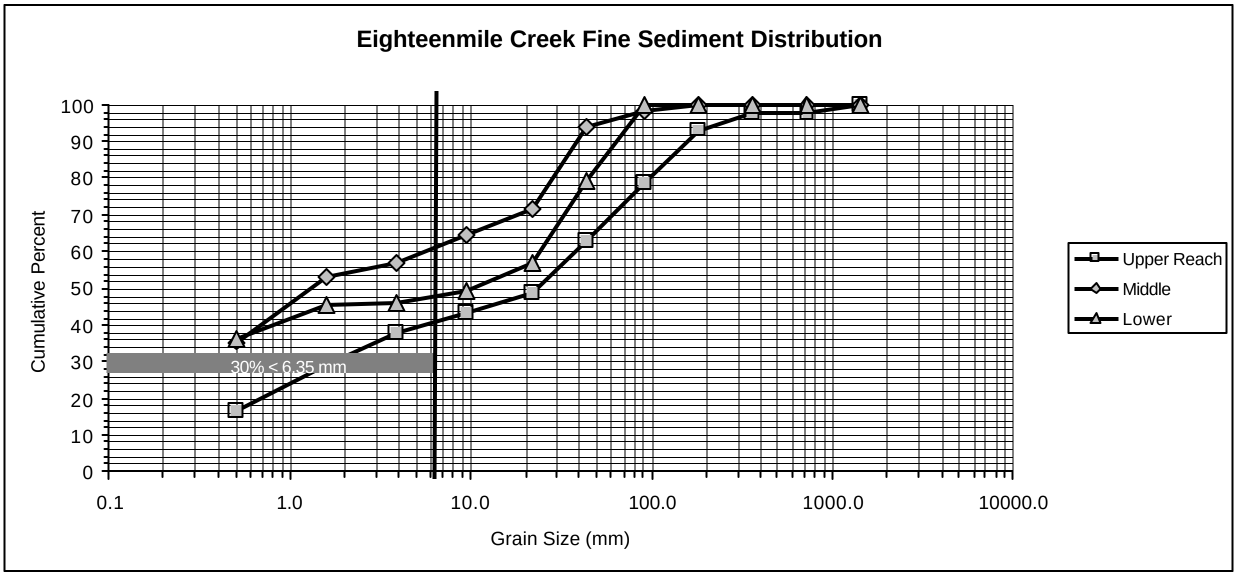


Figure 3.3.2 Surface fine sediment composition associated with BURP sites.

The McNeil sampling data evaluates subsurface fines to a depth of 4 in for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fine sediment less than 0.25 in (6.35 mm). Sampling was done only at one site on public land upstream of the intersection of the Eighteenmile Creek Road and the Oxbow Ranch Road. The mean % fines including substrate 2.5 in (63.5 mm) and greater was 30%, with a standard deviation of 6.5. The mean percent fines not including substrate 2.5 in (63.5 mm) and greater, was 38%, with a standard deviation of 5.1. The mean percent fines less than 0.85 mm (0.03 in) including substrate 2.5 in (63.5 mm)and greater was 6.77%. The mean percent fines less than 0.85 mm (0.03 in) not including substrate 2.5 in (63.5 mm) and greater was 8.6%.

The Streambank erosion inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation developed by the NRCS as a tool to evaluate erosion condition on streambanks, gullies and roads (Appendix A). In 1997, surveys were conducted along 10.7% (2.9 miles) of the total stream length. The evaluation was done along two different reaches to provide a more comprehensive overview. Streambanks along the upper reach were classified as having moderate erosion potential, with an overall rating of 6 out of a potential 15. This equates to a lateral recession rate of 0.08 feet per year, resulting in an estimated sediment yield of 14 tons per year for this reach and a corresponding estimate of 5 tons per mile per year of sediment from streambank erosion over the sample reach. Of the total mainstem stream miles of Eighteenmile

Creek, the upper erosion inventory reach is likely representative of approximately 7 miles. The upper erosion inventory site ranks 20th out of 28 sample reaches surveyed on 13 streams in the Lemhi River watershed. The average estimate of tons of sediment contributed by stream bank erosion per mile for all stream sample sections was 60 tons per mile per year.

Streambanks along the lower reach were classified as having slight-to-moderate erosion potential, with an overall rating of 5 out of a potential 15. This equates to a lateral recession rate of 0.06 feet per year, resulting in an estimated sediment yield of 47 tons per year for this reach and a corresponding rate estimate of 5 tons per mile per year. The lower erosion inventory reach is representative of 11.5 miles of the mainstem stream miles. The lower erosion inventory site ranks 21st out of 28 sample reaches surveyed on 13 streams in the Lemhi watershed. This section is characterized by low gradient, depositional flow with beaver dams and a thick willow/carex and catabrosia riparian zone. The channel is primarily a Rosgen D channel with clay/silt bank material. Sloughing of stream banks is present throughout the sample section, caused mostly by cattle trampling rather than hydrologic processes. Much of the riparian willow population is made up of decadent willows and replacement by younger age classes of willows appears limited. Stream banks in this reach are generally unstable due to trampling.

Aquatic insect communities sampled at an upper and lower site showed scores of 4.2 and 4.5, respectively. Scores greater than 3.5 are indicative of non-impaired macroinvertebrate communities. These samples score high due to the presence of species that show a preference for high water quality.

The HI gives a score based on the natural fish habitat conditions. Eighteenmile Creek falls within the Snake River Basin/High Desert Ecoregion. The upper BURP site score (107) indicates non-impaired conditions, which require a score >88. The lower section score of 80 fails to meet the non-impaired threshold of 88, and falls into the needs verification category (IDEQ 1996), however elevated percentage of sediment in the substrate, diminished flow and bank condition are the primary factors for decreasing habitat scores progressively downstream.

Nutrient grab samples were taken in August 1997 at the lower site. The samples showed a total nitrogen value of .009 mg/l, and a total phosphorus value of 0.08 mg/l, both of which are below nutrient thresholds of 0.3 mg/l nitrogen recommended by Golterman (1975), and 0.1 mg/l phosphorus suggested by EPA (1986). The state nutrient standards are narrative and require waters to be free from nuisance levels of aquatic plants. The streambank erosion inventory notes blue-green algae are present at several locations below the confluence of Divide Creek with Eighteenmile Creek though they have not been determined to be at nuisance levels. Additional evaluation is required to determine the distribution and effect of blue-green algae concentrations in Eighteenmile Creek. It is likely that elevated stream temperature contributes to the proliferation of this algae and that nutrients bound to soils could play a role. It is also likely that natural background nutrient levels would be higher here due to the depositional nature of the stream channel and the function of beaver dams.

It is felt that springs and seepage of ground water is important to moderation of water temperatures below the confluence of Divide Creek. Temperature monitoring shows that water temperature is higher than would be expected for the apparently good condition of the riparian zone and elevation of the upper reaches of Eighteenmile Creek.

The BLM has measured water temperature at the WSA/private boundary since 1994. The average maximum daily temperature over this period is 60.8º F (16.0º C). In 1997, the maximum average daily temperature at this point was 64.2º F (17.9º C), with a maximum seven-day average of maximum temperature of 60.6º F (15.9º C). The WSA is a high elevation, relatively pristine area, which indicates that standard temperature protocols don't fit this system. The beaver complexes above this point appear to have an influence on the temperature, but no measurements have been recorded above these complexes.

DEQ measured water temperature downstream of the "confluence" with Divide Creek. The maximum daily maximum water temperature was 72.2º F (22.3º C), with a maximum seven day average of daily maximum of 68.0º F (20.0º C). Maximum daily water temperature was in excess of the instantaneous standard of 71.6º F (22º C) on one day (7/21/97) with the temperature reaching 72.2º F (22.3º C) at 5:25P.M. with approximately one hour duration. Maximum daily average temperature did not exceed 66.2º F (19º C). Violation of State salmonid spawning temperature criteria occurred during monitoring with regard to rainbow, cutthroat, and brook trout. Instantaneous daily maximum temperature was in excess of 55.4°F (13.0º C) from July 3rd through August 1st and from September 1st through 19th. Maximum daily average temperature was in excess of 48.2º F (9.0º C) from July 3 through August 1 and from September 1 through 19. In 1997, the BLM also recorded water temperature near where the Eighteenmile Creek Road crosses the creek (at the lower BURP site). The maximum daily maximum temperature at this point was 67.7º F (19.8º C), with a maximum seven-day average of daily maximum of 65.2º F (18.4º C).

This system does not meet state water quality temperature standards for coldwater biota or salmonid spawning instantaneous maximum or maximum daily average. However, it is unlikely to, due to the elevated natural temperature regime at the source, combined with the effect of irrigation return and the presence of extensive beaver complexes, despite groundwater influence.

The Eighteenmile Creek watershed is known to produce rainbow, cutthroat and bull trout. Brook trout have also been documented within Eighteenmile Creek (Glenn Elzinga, BLM, personal communication). Bull trout have been listed as a threatened species under the Endangered Species Act and cutthroat trout have been petitioned for listing. The Snake River spring/summer chinook salmon is listed as endangered and historically used the watershed for spawning and rearing, as may have steelhead, another species recently listed as threatened. No anadromous fish are known to currently utilize the

Eighteenmile Creek watershed due to dewatering of the stream channel. The Lemhi River is the closest known currently occupied habitat for these fish.

The BLM and IDFG surveyed Eighteenmile Creek in 1997 to evaluate population densities. Due to the extensive beaver complexes and thick vegetation, these surveys probably did not adequately evaluate the fish populations. Densities were estimated at 2.8 rainbow trout/100 meters^2, and 0.18 bull trout/100 meters^2.

The Eighteenmile watershed has most likely lost the migratory portion of the bull trout population due to habitat fragmentation from seasonal dewatering. Although the remaining resident fish can maintain a viable population, catastrophic natural events have the potential for eliminating these fish completely.

Water Quality Concerns

Eighteenmile Creek is on the §303(d) list for sediments and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses the entire length of stream and the primary land use adjacent to the creek is grazing which occurs over the entire length with irrigated agriculture over the lower reach below the Clear Creek Road. Fifty four percent of the mainstem stream miles are in private ownership and state and federal government land management agencies (BLM and IDL) manage forty six percent.

Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply. The listed reach on Eighteenmile Creek has been determined to Need Verification to show full support of beneficial uses. Sediment deposition as evidenced by percent surface and subsurface fines, and temperature regimes exceed desired values. This watershed will require a TMDL to address sediment loading and potential for support of beneficial uses.

Three historic watergaps for livestock existed on Eighteenmile Creek. These areas allow grazing to accelerate sedimentation inputs from overland flow events such as the spring snowmelt and summer thunderstorms. Two of these areas have been fenced since 1995 to exclude all livestock grazing and allow vegetation recovery. Reduced vegetative cover throughout grazed areas within the watershed may contribute to the increased velocity of overland water flow from spring/summer rainstorms and add sediment to Eighteenmile Creek. Reduced vegetative cover on streambanks throughout grazed areas has reduced streambank stability, increasing streambank erosion. Direct trampling of streambanks by cattle is also increasing streambank erosion. It is currently unknown how influential the activities on the private lands upstream are to water quality in this watershed but impacts may be large.

Nearly every tributary to Eighteenmile Creek, and Eighteenmile Creek itself, are diverted during the growing season to irrigate private lands and provide stock watering within the watershed. Nineteen diversions for a total of 44.41 cfs occur on Eighteenmile Creek or its tributaries. These diversions significantly reduce flow into the upper Lemhi River. The numerous diversions and ditches taking water from the creek reduce the amount of water available during the time adult chinook salmon and other fish species would attempt access to Eighteenmile Creek. Several stretches of Eighteenmile Creek are completely dewatered during irrigation season. The reduced streamflow results in fragmented habitats, with limited available to all life stages of fish. These actions (diversions) are pre-Federal Land Policy and Management Act (FLPMA) and non-discretionary (not optional) to the BLM.

Applicable Criteria
State water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states that, *"Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses..."* In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state, *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."*

State water quality standards that relate to temperature are specific to coldwater biota, salmonid spawning and to bull trout:

"Cold Water Biota: Stream temperature not to exceed 22º C (71.6º F) with a maximum daily average no greater than 19º C (66.2º F).
Salmonid Spawning: Stream temperature not to exceed 13º C (55.4º F) with a maximum daily average no greater than 9º C (48.2º F) . During identified spawning/incubation periods identified for species.
Bull Trout Waters: State of Idaho: Known bull trout spawning and juvenile rearing stream segments: Stream temperature not to exceed 12º C (53.6º F) evaluated on seven-day moving average based on daily average water temperature, or shall not exceed a seven-day moving average of 15º C (59.0º F) based on daily maximum water temperatures, during July, August and September. Bull trout spawning: Stream temperature not to exceed 9º C (48.2º F) from September 1 – April 1."

Load Capacities and Targets
The current state of the science does not allow specification of a sediment or nutrient load or load capacity that is known in advance to meet the narrative criteria for sediment and to fully support beneficial uses for coldwater biota and salmonid spawning. All that can

be said is that the load capacity lies somewhere between the current loading and natural background levels. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for Bohannon Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment standards and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. Existing sediment sources are identified and the opportunity exists through implementation of Best Management Practices (BMP) to gain significant reductions in sediment load. Often nutrients sorbed to sediment are reduced along with sediment reduction and as sediment sources are controlled it is likely that the potential for visible levels of slime growths or other undesirable aquatic plant growth would decline.

Sediment Targets

To improve the quality of spawning substrate and rearing habitat in Eighteenmile Creek, it is necessary to reduce the component of subsurface fines of 6.35 mm and less to below 28 percent. It is also recommended that instream surface fine sediment deposition not increase above 20 percent in spawning habitat. A detailed discussion of surface and subsurface fines target selection is given under Target Identification in section 2.2.

Temperature Targets

Stream temperature within Eighteenmile Creek occasionally may show minor exceedance of State water quality standards for short duration that relate to coldwater biota, and bull trout. To improve the quality of salmonid rearing habitat and to support coldwater biota beneficial uses it would be necessary to reduce the warming of streamwater in Eighteenmile Creek as much as possible below its source. It is unlikely that current state water quality standards for temperature would be met in low flow years even under optimum riparian conditions due to the elevated water temperature at the source of Eighteenmile Creek exacerbated by reduced flow from irrigation diversion. All that can be said is that a decreasing trend in stream temperature is likely with improving riparian conditions. Continued monitoring of stream temperature is warranted in Eighteenmile Creek, while improving riparian conditions as opportunities present themselves.

Loading Summary

Existing Sediment Sources

Numerous roads traverse the Eighteenmile Creek watershed. The longest is the Eighteenmile Creek Road, which runs from Leadore to the Birch Creek Valley, returning to Highway 28 just upstream of Lone Pine. Historic use of the Eighteenmile Creek road has been to access the upper reaches of Eighteenmile Creek. Varying degrees of maintenance and upgrading have occurred in the past, however, no formal survey and design has been completed, especially with regard to BMPs. Much of the area traversed by the upper section of the road contains soils which tend to be high in clay and erosive potential. The combination of generally poor road design, erosive soils, and degraded nature of the riparian zone where the road crosses Eighteenmile Creek sets the stage for obvious, though unmeasured, sediment input to Eighteenmile Creek.

Motorized vehicle travel inside the WSA is currently limited to those few roads and trails in existence at the time of designation as a WSA. These roads do not tend to contribute much sediment to the streams, due to topography and soil type.

McFarland Boulevard (4 miles) has been determined to create seasonally high levels of sediment, which ends up in Eighteenmile Creek via ephemeral drainages and at road crossings. Road segments needing maintenance throughout the Eighteenmile Creek watershed will be designated in 1998 and maintenance will commence in 1999 (BLM Scott Feldhausen Personal Communication).

Riparian habitat condition has been evaluated on 28 miles of Eighteenmile Creek and 9.2 miles of Divide Creek. Riparian habitat condition classes for Eighteenmile Creek and its tributaries are shown in Table 3.3.3. Riparian habitat condition can be an indicator of streambank stability and areas identified as Functioning At Risk can be potential areas of streambank erosion, particularly where a downward trend has been identified. A significant portion of state and private riparian habitat on Eighteenmile Creek is identified as Functioning At Risk with a downward trend. Due to the general lack of connectivity in the watershed, riparian habitat condition in the Eighteenmile Creek watershed is probably not as good an indicator of sediment delivered to Eighteenmile Creek as if the tributaries were perennially connected. Additionally 1.7 miles of riparian habitat on private land is rated as Non-Functional.

The streambank erosion inventory conducted on Eighteenmile Creek shows that the streambank erosion rate is similar for the upper and lower reaches (5 tons per mile per year). The primary difference is in the amount of erosion from similar stream banks. The cumulative erosion from similar streambank erosion is greater from the lower reach because of the greater length of similar streambank erosion. The accumulated bank to bank length for the lower reach is 17,146 feet resulting in 47 tons per year as opposed to 13,756 feet and 14 tons per year over the upper reach.

Estimates of Existing Sediment Load

Anthropogenic fine sediment inputs are primarily a result of streambank erosion, particularly on lower Eighteenmile Creek where sediment load is estimated at 47 tons per year. The upper erosion inventory reach is estimated to produce 14 tons per year.

Unsurfaced roads are numerous in the Eighteenmile watershed however, they are not particularly constricted within the riparian corridor. The primary contribution of sediment load likely comes from the numerous crossings of pioneered roads and fourwheel drive trails, during snowmelt. It is not possible to give a numerical estimate of sediment loading at this point, however, as previously stated, further evaluation is being made of problem areas and BMPs will be identified to reduce sediment load from this source.

Table 3.3.3. Riparian habitat condition classes for streams within the Eighteenmile Creek watershed (all numerical values are miles of stream).

Stream	Length (miles)	Condition												
		Proper Functioning Condition				Functional At Risk/Trend				Non-Functional				Dewatered
		BLM	USFS	State	Pvt.	BLM	USFS	State	Pvt.	BLM	USFS	State	Pvt.	
Eighteenmile	28.0	8.6	0.0	0.0	3.9	0.9 U	0.0	2.2 D	7.9 D	0.0	0.0	0.0	1.7	2.8
Bull	4.4	0.0	2.1	0.0	0.0	1.3 S	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Clear	9.1	3.2	0.1	0.0	0.0	0.0	0.0	1.0 S	0.7 S	0.0	0.0	0.0	0.0	4.1
Divide	9.2	1.0	0.0	0.0	0.0	1.5 S	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
McGinty	9.6	0.0	0.0	0.0	0.0	1.5 S	0.0	0.0	0.0	0.5	0.0	0.0	1.8	5.8
Pass	2.6	0.0	0.0	0.0	0.0	2.0 S	0.0	0.0	0.2 S	0.0	0.0	0.0	0.0	0.4
Poison	3.0	1.5	0.0	0.0	0.0	1.3 S	0.0	0.0	0.2 S	0.0	0.0	0.0	0.0	0.0
TenMile	4.4	0.0	1.0	0.0		1.0 S	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
TOTAL:	70.3	14.3	3.2	0.0	3.9	9.5	0.0	3.2	9.0	0.5	0.0	0.0	3.5	23.2

S indicates a static trend
U indicates an upward trend
D indicates a downward trend

Load Allocations

Using the water quality targets introduced above, sediment load allocations or sediment reductions are outlined for streambank erosion from inventoried reaches. Because the chronic sources of sediment are bank and road surface erosion, it will ultimately be necessary to evaluate the data that is being accumulated on road issues and where possible reduce sediment loading as much as possible from road erosion as is planned in 1999. Redundant roads, where several roads lead to the same general location, should be evaluated for obliteration and re-seeding. Due to the un-constricted nature of roadways in the Eighteenmile watershed it can be anticipated that road closure of redundant roads will not be an effective mechanism to reduce sediment loading from roads. It is easy to go around gates or cut through fences and as such closure would not be cost effective. Therefore, road density should be reduced to less than 1 mile of road per square mile within the riparian corridor of Eighteenmile Creek and its connected tributaries. Table 3.3.4 identifies sediment load allocations from streambank erosion.

These sediment load reductions are designed to meet the established water quality targets (i.e., 20% instream surface fines <6.35 mm and less than 28% depth fines <6.35 mm). Bank erosion reductions are quantitatively linked to tons of sediment per year. An inferential link is developed to show how sediment load allocations will reduce surface and subsurface fines. This link assumes that by reducing chronic sources of sediment there will be a decrease in surface and subsurface fines ultimately improving the status of beneficial uses. Based on existing sediment load from bank erosion on Eighteenmile Creek, a reduction of 77 percent is recommended for upper and lower inventory segments.

Table 3.3.4. Eighteenmile Creek bank and road erosion load allocations.

Reach	**Existing bank erosion**		**Desired bank erosion**		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
Upper	5	14	1	3	77
Lower	5	47	1	11	77

Margin of Safety

The MOS factored in for Eighteenmile Creek load allocations are implicit. The implicit MOS is the conservative assumptions used to develop existing sediment loads. Conservative Assumptions made as part of the sediment loading analysis include: 1) Desired bank erosion rates are representative of background conditions; 2) Cumulatively, the assumptions used in recommending riparian road densities less than 1 mile per square mile are conservative and reflect standards set by local land management agencies based on established riparian management protocol; 3) Water quality targets with regard to instream surface and depth fine sediment are consistent with values measured and set by local land management agencies based on established literature values and incorporates an adequate level of fry survival to provide for stable salmonid production.

Seasonal Variation and Critical Time Periods of Sediment Loading

To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed.

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage, most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example, bank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

3.4 Geertson Creek Sediment TMDL

Watershed Description
The Geertson Creek watershed is located approximately seven miles east of Salmon. The watershed is relatively small, containing a total 10,739 acres of combined state, federal and privately managed lands (Table 3.4.1). Elevation varies from 4,200 feet at the confluence with the Lemhi River, to 10,300 feet. on the Continental Divide to the east. The watershed is bounded by the Bohannon Creek watershed to the southeast, with the Kirtley Creek watershed and several unnamed tributaries in the Lemhi River watershed to the northwest.

Table 3.4.1. Land ownership within the Geertson Creek watershed.

Geertson Creek	Total	BLM	USFS	State	Private
Watershed Acres	10,739	4,722	265	502	3,720
Mainstem Stream Miles	10.5	4.1	0.2	0.6	5.6
Watershed Stream Miles	13.8	5.9	0.2	0.6	7.0
Percent Watershed Acres	100%	44%	3.1%	4.5%	48.4%
Percent Watershed Stream Miles	100%	43%	1.5%	4.4%	51.1%

The topography is similar to most watersheds in this area, with a split between the lower riverine benches and the higher, steeper slopes, with 20-30% of the area exceeding 40% slope. Approximately 4.1 miles of the upper reaches of Geertson Creek are on BLM administered land. Almost the entire BLM portion lies within a very narrow, steep-walled canyon which opens only slightly at the uppermost end. A small grassy meadow ending in a terminal moraine approximates the BLM/USFS boundary. The south-facing canyon wall is extremely steep and rocky with a variable cover of primarily Douglas fir, small inclusions of aspen, and sagebrush/grass. The north facing slopes are more uniformly covered with dense Douglas fir occasionally interrupted by small sagebrush/grass openings. Avalanche chutes and sparse woody vegetation characterizes both slope aspects in the canyon. Table 3.4.2 summarizes the watershed geomorphic characteristics for Geertson Creek.

Table 3.4.2. Geertson Creek watershed geomorphic characteristics.

drainage area (square miles)	14.3
drainage density	1
maximum elevation (ft)	10,300
minimum elevation (ft)	4,200
relief ratio	0.11
total road length (miles)	25.97
road density (miles/square mile)	1.8

This TMDL addresses sediment loading on Geertson Creek. Geertson Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. At the middle BURP site the presence of filamentous blue-green algae was noted at the upper survey reach, as part of the assessment. This blue-green algal growth could be indicative of elevated levels of nutrients, but is felt to be localized. It is not felt that the algal growth described in the BURP survey is at nuisance levels, however, and continued monitoring of nutrient levels and aquatic plants is warranted. This listing definition encompasses approximately the lower half of the creek. The primary land use adjacent to the §303(d) listed segment is grazing with irrigated agriculture.

Beneficial Use Support Status and Pollutants of Concern
Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.

The listed reach on Geertson Creek has been determined to Need Verification to show full support of salmonid spawning and coldwater biota beneficial uses. Increased sediment deposition, as evidenced by percent surface and subsurface fines, exceeds desired values and conditions. Figure 3.4.1 shows Geertson Creek gradient profile with associated sampling sites.

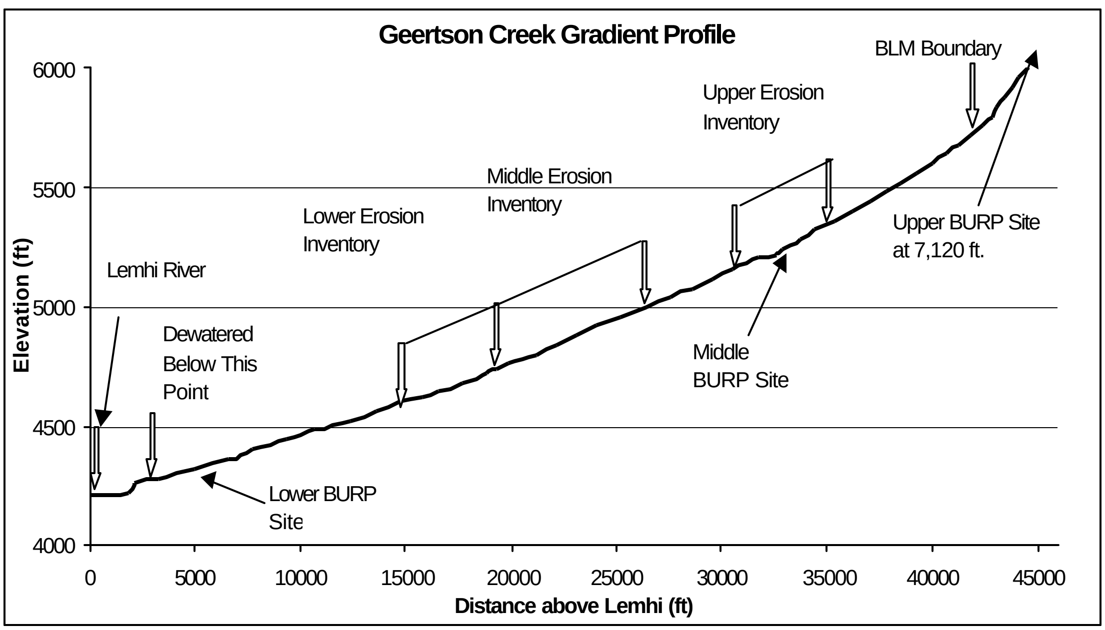


Figure 3.4.1 Geertson Creek gradient profile with associated sample sites and boundaries (vertical exaggeration 11:1).

Existing Conditions
Geertson Creek drains the lower of two lakes located in a rocky basin on USFS land near the Continental Divide. It then flows 10.5 miles southwesterly through rugged, forested uplands and arid sagebrush country toward the Lemhi River. Geertson Creek is

permanently diverted into a lateral ditch and does not reach the Lemhi River. The stream is generally a high gradient (5-10+ %) rocky stream with a mainstem base flow of 1-10 cfs, depending on diversions. Channel type depends primarily on gradient, with A channels in the upper portions and B channels downstream. The stream has a dense tree/shrub overstory. The creek has one perennial tributary, Gary Creek, which flows across BLM and private lands. It has a base flow of approximately 0.5 to 1.0 cfs.

There are many claims to the water in Geertson Creek. From March 15 to November 15 there are 12 claims, which combined, withdraw a total of 12.54 cfs. From April 1 to November 1 there are an additional 11 claims for 12.82 cfs.

The BLM only has one established monitoring site within the watershed. Water temperature monitoring has been conducted at this site since 1995. The USFS conducts no monitoring within the watershed, as they manage only the very uppermost portion of the watershed, near the peaks.

The IDEQ sampled water quality parameters at three sites on Geertson Creek. Sampling was conducted using the BURP protocols. The upper-most site is approximately 2 miles above the BLM boundary (T22N R23E SW1/4 SE1/4 SE1/4 of Section 14 on the Bohannon Spring Quadrangle). The next downstream site is approximately 10m below the confluence of Gary Creek with Geertson Creek (T22N R23E NW1/4 SW1/4 SW1/4 of Section 34 on the Bohannon Spring Quadrangle). The lower evaluation site is approximately 1.5 miles upstream from the confluence of Geertson Creek with the Lemhi River (T21N R23E NE1/4 SE1/4 SE1/4 OF Section 19 on the East of Salmon Quadrangle). McNeil sediment core samples and nutrient samples were collected on the Don EnEarl property located approximately 3 miles below the confluence of Gary Creek.

Sediment analysis included McNeil core sampling and a streambank erosion inventory. The McNeil sampling data evaluates subsurface fines to a depth of 4 in for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fines less than 0.25 in (6.35 mm). The mean % fines including substrate 2.5 in (63.5 mm) and greater was 27.8%, with a standard deviation of 2.9. The mean % fines, not including substrate 2.5 in (63.5 mm) and greater, was 31.7%, with a standard deviation of 5.7. The mean % fines less than 0.85 mm (0.03 in) including substrate 2.5 in (63.5 mm) and greater was 7% and excluding 2.5 in (63.5 mm) and greater was 8%. Wolman pebble counts show 1% of surface particles less than 0.25 in (6.35mm) diameter at the upper BURP site and 44% and 58% at the middle and lower BURP sites respectively.

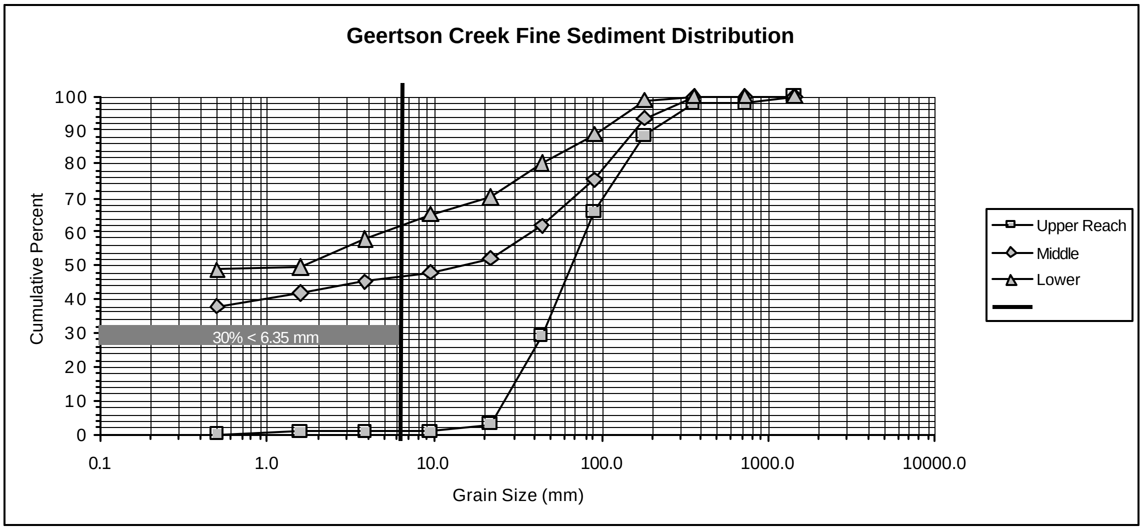


Figure 3.4.2. Surface fine sediment composition associated with BURP sites

The streambank erosion inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation developed by the NRCS as a tool to evaluate erosion condition on streambanks, gullies and roads (Appendix A). In 1997, surveys were conducted along 19.4% (1.3 miles) of the listed reach length. The evaluation was done along three different reaches, to provide a more comprehensive overview. The average estimate of tons of sediment contributed by stream bank erosion for all stream sample sections surveyed was 60 tons per mile per year.

Streambanks along the lowermost reach were classified as having slight erosion potential, with an overall rating of 4 out of a potential 15. This equates to a lateral recession rate of 0.09 feet per year, resulting in an estimated sediment yield of 116 tons per year for this reach and a corresponding rate estimate of 30 tons of sediment per mile per year from stream bank erosion over the sample reach. This ranks 13th out of 28 sample reaches surveyed on 13 streams in the Lemhi watershed.

Streambanks along the middle reach were classified as having slight erosion potential, with an overall rating of 1 out of a potential 15. This equates to a lateral recession rate of 0.01 feet per year, resulting in an estimated sediment yield of 1 ton per year for this reach and a corresponding estimate of 1 ton of sediment per mile per year from stream bank erosion over the sample reach. These two sample reaches are probably representative of 1 mile below this reach and 1 mile above. When extrapolated the total bank erosion for this reach is 2 tons per mile per year.

Streambanks along the upper reach were classified as having moderate erosion potential, with an overall rating of 7 out of a potential 15. This equates to a lateral recession rate of 0.15 feet per year, resulting in an estimated sediment yield of 385 tons per year for this reach and a corresponding estimate of 302 tons of sediment per mile per year from stream bank erosion over the sample reach. This ranks as the highest streambank erosion of 28 sample reaches assessed in the Lemhi River watershed and is likely representative of one mile of Geertson Creek below the confluence of Gary Creek. The ranking of this segment is high due to the average slope height of the inventoried streambanks. The extrapolated erosion estimate, based on similar streambank and gradient conditions is 489 tons of sediment per year.

Aquatic insect communities sampled at the upper and lower sites on Geertson Creek showed scores of 5.3 and 5.0, respectively. Scores greater than 3.5 are indicative of non-impaired macroinvertebrate communities. These samples score high due to the presence of macroinvertebrate species that have a preference for high water quality.

Nutrient samples taken in August 1997 show a total nitrogen value of 0.041mg/l and 0.038 mg/l, and a total phosphorus value < 0.05 mg/l, neither of which exceed the recommended threshold of 0.3 mg/l suggested by Golterman (1975) or the EPA (1986) suggested phosphorus threshold of 0.1 mg/l.

The HI gives a score based on the natural fish habitat conditions. The sites on Geertson Creek fall within the Snake River Basin/High Desert Ecoregion. The score of 91 at the upper site meets the non-impaired threshold of a score >88, indicating non-impaired conditions. The score of 78 at the lower site fails to meet the non-impaired threshold, and falls into the needs verification category (IDEQ 1996).

The BLM has recorded water temperature at one site, on the lowest portion of public land, since 1994. The maximum temperature has averaged 54.7° F (12.6° C) over the past four years, ranging from 52.9° F (11.6° C) in 1995 to 56.5° F (13.6° C) in 1994. In 1997, the seven-day maximum average recorded was 55.0° F (12.8° C) with a peak temperature of 55.9° F (13.3° C) which likely violates the EPA bull trout water temperature standard. There is only one small diversion above this point, so the temperature regime has not been significantly impacted by reduced flows.

Water Quality Concerns

Geertson Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses the lower half of the creek. The primary land use adjacent to the listed segment is grazing and irrigated agriculture with stock watering. Land ownership along the listed segment is private with associated water rights. Stream temperature is within state water quality standards for coldwater biota and salmonid spawning. The condition of riparian habitat and streambank stability is good to excellent over much of the listed reach, however the upper erosion inventory segment exhibits high streambank erosion that is likely impacting the stream below.

The primary water quality concern is related to fine sediment deposited on the surface of stream substrate and below the surface of stream substrate. Surface and subsurface fine sediment 0.25 in (6.35 mm) increases as you move downstream. Subsurface fine sediment is at or slightly above desirable levels. There is not recent fish sampling data to show full support for salmonid spawning in Geertson Creek and it is likely that there is a relationship between elevated fine sediment composition of the substrate and success of spawning fish. Contributing factors could be unscreened irrigation diversions and reduced stream flows that limit the ability of the stream to move fine sediment. It is also possible that other habitat components important to rearing fish are reduced or absent over the listed reach.

Rainbow trout, cutthroat trout, rainbow-cutthroat hybrid trout and bull trout are documented present in Geertson Creek and Geertson Lake, at the headwaters. Bull trout are listed as a threatened species under the Endangered Species Act and cutthroat trout are proposed for listing. It is evident that there is successful spawning activity occurring in the Geertson Creek watershed. This is shown by the presence of salmonids, particularly bull trout, despite the lack of connectivity with the Lemhi River. Spawning is likely fully supported in the canyon above the BLM boundary, but could be extended below the BLM boundary with a reduction in subsurface fine sediment. This would reduce the increased risks of effect to fish from catastrophic events, which is elevated by the lack of connectivity with the Lemhi River.

Applicable Criteria

State water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states, *"Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses..."* In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state, *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."*

Load Capacities and Targets

The current state of the science does not allow specification of a sediment or nutrient load or load capacity that is known in advance to meet the narrative criteria for sediment and to fully support beneficial uses for coldwater biota and salmonid spawning. All that can be said is that the load capacity lies somewhere between the current loading and natural background levels. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for Geertson Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment standards and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. Existing sediment sources are identified and the opportunity exists through implementation of BMPs to gain significant reductions in sediment load. Often nutrients adsorbed to sediment are reduced along with sediment reduction and as sediment sources are controlled it is likely that visible levels of slime growths or other undesirable aquatic plant growth would decline and not reach nuisance levels.

Sediment Targets

To improve the quality of spawning substrate and rearing habitat in Geertson Creek, it is necessary to reduce the component of instream surface and subsurface fines of 6.35 mm and less to below 20 and 28 percent, respectively. A detailed discussion of subsurface fines target selection is given under Target Identification in section 2.2.

Loading Summary

Existing Sediment Sources

The Geertson Creek watershed has 26 miles of roads, of which 7.1 (27.3%) miles are improved gravel, 6.8 miles (36.2%) are unimproved and 12.1 miles (46%) are two-track and four wheel drive roads. Road densities are calculated at 1.5 miles per square mile within the Geertson Creek watershed. Within the canyon an unimproved four-wheel drive road follows and crosses the stream course beginning on the upper segment of private land and continuing up to the outlet of Geertson Lake. Due to its rough condition, this road is barely passable to trucks beginning at the private/BLM boundary. There are several old mining roads that leave this four-wheel drive road toward Kirtley and Gary Creeks.

Steep canyon walls and erosive quartzitic soils characterize the Geertson Creek watershed over the upper half. The four-wheel drive road that parallels Geertson Creek for approximately 3.5 miles in the canyon is constrained within the riparian zone by the narrow canyon. Based on aerial photo interpretation, there are at least four stream crossings. Approximately 75% of the road is within 25 m of the stream. The potential for sediment transport from this road into Geertson Creek is high and it is likely a significant source of sediment even though it is a limited access road. In places, at elevated flow, the stream flows on the road surface for up to ½ mile as stated in the BURP assessment for the upper BURP site, 2 miles above the BLM boundary.

Riparian habitat condition has been evaluated on 10.5 miles of Geertson Creek and 3.0 miles of Gary Creek by BLM. On BLM land along Geertson Creek, 3.7 miles of stream, 4.0 miles of private land and 0.2 miles of USFS land were classified as having riparian habitat in Proper Functioning Condition. On private land 0.1 miles were classified as Non-Functional. Riparian habitat conditions adjacent to the upper erosion inventory reach are rated as Functional At Risk with a static trend (0.4 miles of BLM and 2.1 miles of private land). This area has historically been impacted by livestock due to the easy access livestock has to the creek here. These impacts have resulted in the stream losing some of its ability to deal with high flows and subsequent bank damage. However, much of the channel is heavily cobbled preventing significant additional stream downcutting. This reach of Geertson Creek ranks as the highest streambank erosion rate evaluated within the Lemhi Subbasin Assessment.

Of the 3 miles of Gary Creek riparian habitat condition evaluation shows 1.0 mile of BLM land as Proper Functioning Condition and 0.6 miles as Functional At Risk with a static trend. On private land 1.4 miles were evaluated at Functional At Risk with a static trend.

The streambank erosion inventory conducted on Geertson Creek shows that the primary source of sediment from streambank erosion occurs over the upper evaluation reach, adjacent to the confluence of Gary Creek. Streambank erosion here ranks as the highest of the streams evaluated in the Lemhi River subbasin. The middle and lower reaches had lower erosion rates. Streambank erosion inventory was not conducted on Gary Creek due to access and time constraints. Riparian habitat condition evaluation for Gary Creek is Functional At Risk with a static trend and likely has streambank erosion rates similar to the upper erosion inventory on Geertson Creek.

Estimates of Existing Sediment Load
Anthropogenic fine sediment inputs are primarily a result of streambank erosion on Geertson and Gary Creek and the Geertson Canyon BLM road. Gully erosion and mass failure do not appear to be significant sediment sources in the Geertson Creek watershed. Sediment load to Geertson Creek was quantified using field surveys and aerial photos. Bank erosion was inventoried over representative reaches above the Lemhi River. Specifics regarding the bank erosion inventory method are described in Appendix A.

Erosion estimates were based on the distance of the stream from the road and the gradient of the road for each 40-foot contour interval from the USGS quad maps and orthoquads. Erosion was totaled by the distance to the stream in 25 m increments from 25 m or less to 100 m or less and accumulated by the length of road within the distance to stream increments. Surface erosion and sediment delivery is greatest where roads are hydrologically connected to the stream channel, for example where a road crosses a stream or where a road is constructed directly adjacent to a stream (typically within 300 feet). From the WEPP model it is estimated the Canyon Road produces 104 tons of sediment per year, and of this total, 81 tons of sediment are contributed from road segments within 25 m of the road.

Based on results from streambank erosion inventories, the existing erosion rate ranges from 1 to 302 tons per mile per year. Data indicate that the upper reach adjacent to the confluence of Gary Creek is eroding at a substantially greater rate than the lower sections. When the erosion rate is extrapolated to similar stream channel conditions it is estimated that Geertson Creek receives 489 tons of sediment per year from the upper erosion inventory reach. It is estimated that the middle reach receives 45 tons of sediment per year and the lower reach receives 2 tons per year. The two miles of Gary

Creek rated as Functional At Risk are likely contributing sediment at a lesser rate due to its smaller watershed area and lower base flow. For the purpose of this TMDL the existing sediment load from Gary Creek will be estimated at 100 tons per year.

Load Allocations
Using the water quality targets introduced above, sediment load allocations or sediment reductions are outlined in this section (Table 3.4.3).

Table 3.4.3. Geertson Creek bank and road erosion load allocations.

Reach	**Existing bank erosion**		**Desired bank erosion**		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
Upper	302	385	16	20	95
Middle	1	1	4	4	0
Lower	30	116	9	36	69
Gary Cr.	100	200	5	10	95
Canyon Rd.	28	81	14	40	51

Because the chronic sources of sediment are bank and road surface erosion, quantitative load allocations are developed. These sediment load reductions are designed to meet the established water quality targets (20% instream surface fines and less than 28% depth fines). Bank erosion reductions are quantitatively linked to tons of sediment per year. An inferential link is developed to show how sediment load allocations will reduce subsurface fines. This link assumes that by reducing chronic sources of sediment there will be a decrease in surface and subsurface fines ultimately improving the status of beneficial uses. Based on the existing sediment load from bank erosion, a 95 and 69 percent reduction of sediment from bank erosion is recommended on the upper and lower reaches respectively. It is recommended to maintain current conditions over the middle reach. A reduction of 95 percent is also recommended for Gary Creek. It is recommended that the sediment from the BLM road within the Geertson Creek Canyon be reduced by 51%.

Margin of Safety
The MOS factored in for Geertson Creek load allocations are implicit. The implicit MOS are the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include: 1) Desired bank erosion rates are representative of background conditions; 2) Cumulatively, the assumptions used in the WEPP model are conservative; 3) Water quality targets with regard to instream surface and depth fine sediment are consistent with values measured and set by local land management agencies based on established literature values and incorporates an adequate level of fry survival to provide for stable salmonid production and sustained coldwater biota.

Seasonal Variation and Critical Time Periods of Sediment Loading

To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed.

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage, most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example bank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

3.5 Kirtley Creek Sediment TMDL

Watershed Description
The Kirtley Creek watershed is located east of the town of Salmon. The watershed encompasses 14,299 acres of combined private, state and federally managed lands (Table 3.5.1). Elevation in the watershed ranges from 4,200 feet where Kirtley Creek reaches the Lemhi River, up to 10,300 feet on the rugged Continental Divide (Table 3.5.2). From its source, at the confluence of the East Fork of Kirtley and the North Fork of Kirtley Creek below the Divide, Kirtley Creek initially flows through coniferous forests in the steeper, upper portion of the watershed, before it continues southwesterly through rolling, sage covered foothills. Topography in this watershed is relatively gentle compared with some of the other watersheds in the Lemhi River subbasin, with only 20%-30% of the area exceeding 40% slope.

Table 3.5.1. Land ownership within the Kirtley Creek watershed.

Kirtley Creek	**Total**	**BLM**	**USFS**	**State**	**Private**
Watershed Acres	14,229	7,284	605	834	5,576
Mainstem Stream Miles	7.2	0.0	0.0	0.0	7.2
Watershed Stream Miles	17.3	5.3	0.5	1.4	10.1
Percent Watershed Acres	100%	51.0%	4.2%	5.8%	39.0%
Percent Watershed Stream Miles	100%	30.6%	2.9%	8.1%	58.4%

The effects of placer mining have irreversibly altered large portions of the valley bottom. The signs of this activity are visible throughout the lower portions of the watershed. Placer mining has constrained the stream channel of Kirtley Creek over the mined area and affected the stability of streambanks below.

Typical of land ownership patterns across most of the streams in the area, the lower more level parts of the valley bottom are privately owned. The BLM administers most of the upper watershed between the lower private holdings and a small piece of National Forest along the Divide. On this part of Kirtley Creek, stream gradients are high, and minimal grazing occurs on the stream itself. Small roads extend up both forks of the stream, but end soon after they reach BLM. Due to a lack of road access and limited livestock grazing above this point, the upper watershed is nearly pristine all the way to the Continental Divide. Table 3.5.2 shows Kirtley Creek geomorphic characteristics.

This TMDL addresses sediment loading on Kirtley Creek. Kirtley Creek is on the 1996 §303(d) list for sediment and metals contamination from its headwaters at the confluence of the North Fork of Kirtley Creek and the East Fork of Kirtley Creek to its confluence with the Lemhi River. This listing definition encompasses approximately the lower 2/3 of the watershed. The primary land use adjacent to the §303(d) listed reach is gravel mining, placer mining, irrigated agriculture and grazing.

Table 3.5.2. Kirtley Creek watershed geomorphic characteristics.

drainage area (square miles)	21.8
drainage density	0.8
maximum elevation (ft)	10,300
minimum elevation (ft)	4,200
relief ratio	0.16
sediment deposition ratio	0.3
sediment transport potential	0.4
total road length (miles)	39
road density (miles/square mile)	1.8

The likelihood of adverse effects of metals contamination was evaluated through synoptic sampling of surface water in the Kirtley Creek watershed in October 1997 and sediment chemical analyses in August 1998. Results showed that water and sediment metals concentrations were low in comparison to criteria and guidelines, and in comparison with upstream and regional background concentrations (Appendix F). No further investigations or management measures for metals contamination appears warranted.

Beneficial Use Support Status and Pollutants of Concern

Designated beneficial uses for the listed reach include secondary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply.

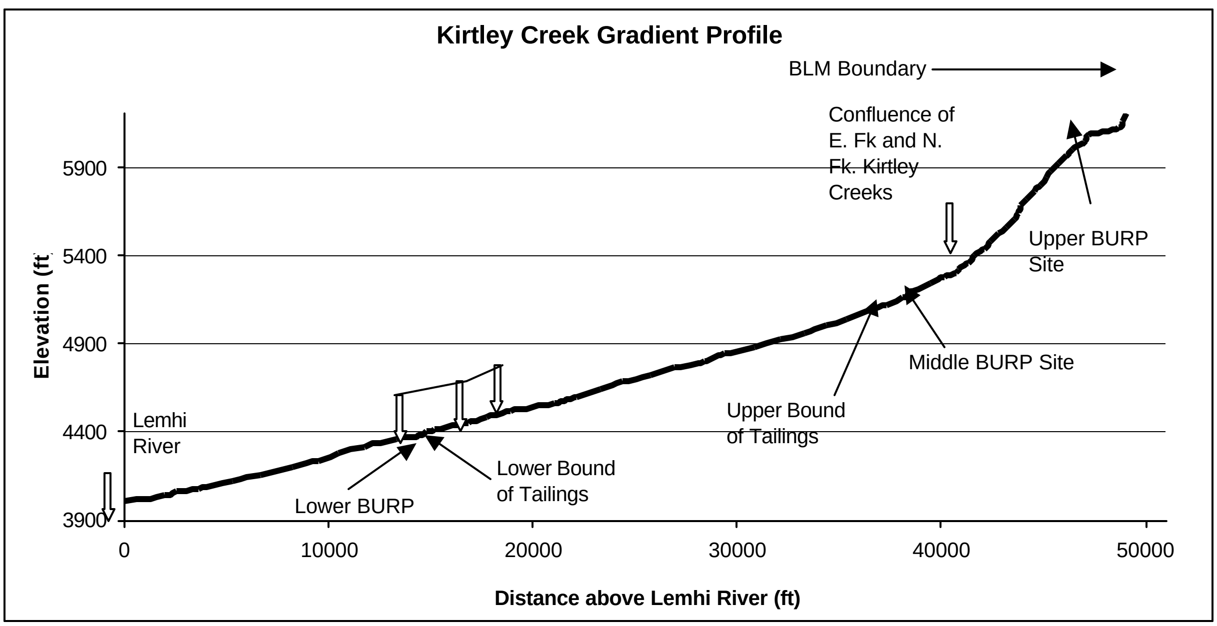


Figure 3.5.1 Kirtley Creek gradient profile with associated sample sites and boundaries (vertical exaggeration 10:1)

The listed reach on Kirtley Creek has been determined to Need Verification to show full support of Salmonid Spawning and Coldwater Biota beneficial uses. Sediment deposition as evidenced by percent subsurface fines exceeds desired values and conditions.

Existing Conditions
Kirtley Creek is characterized by a mainstem base flow of 1-19 cfs, depending on diversions. Gradient ranges from 10+% (41% of the stream length) in the upper portion of the watershed to less than 4% (51% of stream length) in the lower valley. Channel type varies correspondingly, with the majority of the stream in A and B channels. There are several seeps and springs, which contribute to the base flow of Kirtley Creek, and two main tributaries, the East Fork and the North Fork. These two tributaries, which flow from springs and a lake near the Continental divide, form the mainstem of Kirtley Creek at their confluence.

Kirtley Creek does not reach the Lemhi year-round due to multiple irrigation diversions that dewater it. The watershed has 21 private water right claims for a combined total permitted withdrawal of 21.08 cfs from March 15 to November 15. All diversion sites are unscreened.

Neither the BLM nor the USFS have any established riparian monitoring sites within the watershed. The IDEQ sampled water quality parameters at three sites on Kirtley Creek, one on the BLM and two on private. Sampling was conducted using the BURP protocols. The upper most BURP site on BLM land is on the North Fork of Kirtley Creek three fifths of a mile above its confluence with the East Fork of Kirtley Creek (T22N R23E NE1/4 SE1/4 NW1/4 of Section 16 on the Bohannon Spring Quadrangle). The next downstream site is approximately 1/3 mile below the confluence of the North and East forks of Kirtley Creek (T22N R23E SW1/4 NE1/4 NE1/4 of Section 20 on the Bohannon Spring Quadrangle). The lower site on Kirtley Creek is 1.5 miles above the first cattle guard, approximately 3 miles above the confluence of the remnant natural stream channel of Kirtley Creek with the Lemhi River (T21N R22E NE1/4 NE1/4 NW1/4 of section 01 on the East of Salmon Quadrangle).

McNeil sediment core samples and temperature data were collected at the lower bound of the middle BURP site. Nutrient samples were collected ½ mile below the lower BURP site just above the culvert on the residential road that branches from Kirtley Creek Road 1.6 miles above the old highway. Water samples for metals analysis were collected above and below the placer mined areas on Kirtley Creek. Erosion inventories were conducted from the Bennett property upstream into placer mining tailings, with approximately 4,500 feet of the stream inventoried.

Sediment analysis included McNeil core sampling and stream bank erosion inventory. The McNeil sampling data evaluates subsurface fines to a depth of 4 in for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fine particles less than 0.25 in (6.35 mm). The mean % fines including substrate 2.5 in (63.5 mm) and greater was 23.6%, with a standard deviation of 3.1. The mean % fines, not including substrate 2.5 in (63.5 mm) and greater, was 33.3%, with a standard deviation of 3.4. Wolman pebble counts show 16% of surface particles less than 0.25 in (6.35 mm) at the upper BURP site, 6% at the middle site and 19% at the lower site. Surface fine sediment composition at each of the sample sites is shown in Figure 3.5.2.

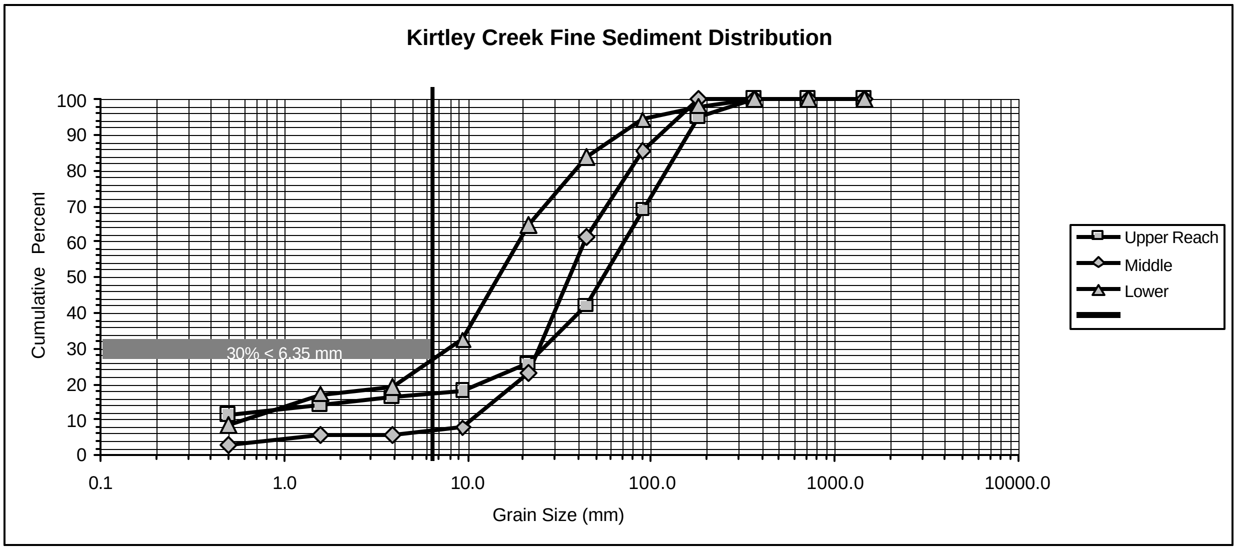


Figure 3.5.2 Surface fine sediment composition at each of the Kirtley Creek BURP sites

The Bank Erosion Inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation developed by the NRCS as a tool to evaluate erosion condition on streambanks, gullies and roads. In 1997, a survey was conducted along 7.3% (0.85 miles) of the listed reach length. The evaluation was done on two reaches. Streambanks along the upper reach were classified as having moderate erosion potential, with an overall rating of 7 out of a potential 15. A lateral recession rate of 0.5 feet per year was determined, resulting in an estimated sediment yield of 1331 tons per year for this reach with a corresponding estimate of 268 tons per mile per year of sediment from stream bank erosion over the sample reach. This ranks 2nd out of 28 sample reaches surveyed on 13 streams in the Lemhi River watershed. The inventory reach is representative of 4 miles of similar streambanks which include the placer tailings. The Lemhi River subbasin average was 60 tons per year for all reaches surveyed.

Streambanks along the lower reach were classified as having severe erosion potential, with an overall rating of 12 out of a potential 15. A lateral recession rate of 0.5 feet per year was determined, resulting in an estimated sediment yield of 166 tons per year for this reach with a corresponding estimate of 125 tons per mile per year of sediment from stream bank erosion over the sample reach. This ranks 4th out of 28 sample reaches surveyed on 13 streams in the Lemhi River watershed. The inventory reach is representative of 3.2 miles of similar streambanks below the tailings. The Lemhi River subbasin average was 60 tons per year for all reaches surveyed.

Aquatic insect communities sampled at the upper, middle, and lower sites on Kirtley Creek showed scores of 4.9, 5.7 and 5.3, respectively. Scores greater than 3.5 are indicative of non-impaired macroinvertebrate communities. These samples score high due to the presence of macroinvertebrate species, which require cold water to survive.

The HI gives a score based on the natural fish habitat conditions. All three sites on Kirtley Creek fall within the Snake River Basin/High Desert Ecoregion. The score of 103 (upper site), 90 (middle site) and 91 (lower sites) meet the required threshold of a score >88, indicating non-impaired conditions.

Nutrient grab samples taken in August 1997 showed a total nitrogen value of <0.05 mg/l, and a total phosphorus value of <0.05 mg/l, both of which are below nutrient thresholds recommended by EPA (1986), and Golterman (1975). Scores less than 0.3 for nitrogen and 0.1 for phosphorus are required to meet the recommended thresholds.

On October 31, 1997 four water samples were collected at a location above and below the placer mined areas on Kirtley Creek. These samples were collected to determine if surface water quality has been impacted by past and present placer mining activities. Samples were analyzed for 12 metals, hardness, sulfates, specific conductance, and pH. Filtered preserved and unfiltered not preserved water samples were collected on Kirtley Creek above and below the placer operations. The lower sample on Kirtley Creek was collected adjacent to the Bennett home. This site is below all placer disturbances. Results of this reconnaissance sampling showed that with the exception of copper, there were no exceedances of the applicable water quality standards for metals. The reported results for copper below the placered section slightly exceeded the criterion maximum concentration (CMC) for the protection of aquatic life (10 ? g/l versus the CMC of 7 ? g/l). However, the method detection limit for copper was 10 ? g/l, so the reported result of 10 ? g/l was below the practical quantitation limit for copper. Thus the available information suggests that dissolved metals contamination is not a significant water quality concern on Kirtley Creek and this is supported by the 1998 sampling data described in Appendix F.

The BLM monitored water temperature on the North Fork of Kirtley Creek, upstream of the state/private land boundary, in 1997. The maximum water temperature was 53.2? F (11.8? C), with a seven-day average maximum of 52.7? F (11.5? C) which is likely a violation of EPA bull trout criteria. DEQ temperature monitoring was conducted on Kirtley Creek at the lower end of the middle BURP site. Data was collected hourly from July 1 to October 30, 1997. Maximum daily maximum water temperature was 66.7? F (19.3? C) and the maximum 7-day sliding average of daily maximum was 60.7° F (15.9? C). Violations with regard to instantaneous maximum and maximum daily average occur from July 3 through August 1 for rainbow and cutthroat trout for this monitoring period. Additionally State bull trout temperature criteria are exceeded from July 4 through September 10 in terms of the 7 day sliding average of the daily average and daily maximum temperatures.

Water Quality Concerns

The primary water quality concern is related to subsurface fine sediment deposited within the stream substrate. Subsurface fine sediment is above desirable levels. There is not recent fish sampling data to show full support for salmonid spawning in Kirtley Creek and it is likely that there is a relationship between elevated subsurface fine sediment composition of the substrate and success of spawning fish. Contributing factors could be unscreened irrigation diversions and reduced stream flows that limit the ability of the stream to move fine sediment. It is also possible that other habitat components important to rearing fish are reduced or absent over the listed reach.

Rainbow and westslope cutthroat trout, brook trout and bull trout are documented present in Kirtley Creek. Westslope cutthroat trout have been petitioned for listing under the Endangered Species Act and bull trout are listed as a threatened species. It is evident that there is successful spawning activity occurring in the Kirtley Creek watershed. This is shown by the presence of salmonids, particularly cutthroat trout and bull trout, despite the lack of connectivity with the Lemhi River. There is no documentation of present or historical planting of salmonids in the Kirtley Creek watershed. Salmonid spawning is likely fully supported in upper Kirtley Creek, below the BLM boundary, as evidenced by the presence of native salmonids, but could be extended downstream with a reduction in subsurface fine sediment. This would reduce the increased risks of effect to the fish population from catastrophic natural events, which is elevated by the lack of connectivity with the Lemhi River.

The rate of streambank erosion on Kirtley Creek is among the highest surveyed in the Lemhi subbasin, and poses potential risk of further degradation of water quality if not stabilized. The effects of sedimentation are exacerbated by reduced flow from irrigation diversion and the effect reduced flow has on stream temperature. Kirtley Creek appears to be within state water quality standards for temperature, however only slightly below the threshold of exceedance.

Applicable Criteria

Idaho water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states, *"Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses..."* In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state, *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."*

Load Capacities and Targets

The current state of the science does not allow specification of a sediment load or load capacity that is known in advance to meet the narrative criteria for sediment and to fully support beneficial uses for coldwater biota and salmonid spawning. All that can be said is that the load capacity lies somewhere between the current loading and natural background levels. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for Kirtley Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load indicator targets, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment standards and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. Existing anthropomorphic sediment sources are identified and the opportunity exists through implementation of Best Management Practices (BMP) to gain significant reductions in anthropomorphic sediment load.

Sediment Targets
To improve the quality of spawning substrate and rearing habitat in Geertson Creek, it is necessary to reduce the component of subsurface fines of 6.35 mm and less to below 28 %. It is also recommended that instream surface fine sediment deposition not increase above 20 % in spawning habitat. Current instream surface fine sediment composition should be maintained at or below observed levels. A detailed discussion of subsurface fines target selection is given under Target Identification in section 2.2.

Loading Summary

Existing Sediment Sources
The Kirtley Creek watershed has 39.3 miles of roads, of which 7.6 miles (19.3%) are improved gravel, 20.0 miles (51.0%) are unimproved and 11.7 miles (29.7%) are two-tracks. Road densities have been calculated at 1.76 miles per square mile.

Due to the highly erosive nature of the soils and the proximity of most roads to the stream channel, some erosion can be expected, but the degree of erosion is unknown. These roads are generally on private land and are of an unmaintained two-track nature. The main Kirtley Creek road and the four wheel drive trails associated with the North and East Forks of Kirtley Creek are generally within 25 meters of the stream. The WEPP model was used on these road segments to estimate the sediment contribution from road surface erosion (Appendix A). For the purpose of this estimate 4,627 feet of the upper Kirtley Creek Road, 5,124 feet of the East Fork Kirtley Creek four wheel drive trail, and 3,682 feet of the North Fork Kirtley Creek four wheel drive trail were evaluated because of their proximity to the streams, generally within 25 meters.

Riparian habitat condition has been evaluated on 7.2 miles of Kirtley Creek, 3.4 miles of the East Fork of Kirtley Creek and 3.6 miles of the North Fork of Kirtley Creek. On Kirtley Creek the evaluation was entirely on private land. Seven miles of Kirtley Creek was rated as Functioning at Risk with a static trend and 0.2 miles were dewatered. All of the 3.4 miles of the East Fork of Kirtley and the 3.6 miles evaluated on the North Fork of Kirtley Creek were rated as Proper Functioning Condition.

The streambank erosion inventory conducted on Kirtley Creek shows that the primary source of sediment from streambank erosion occurs over the upper evaluation reach adjacent to placer tailings. However, the lower erosion inventory reach also produces significant amounts of sediment from streambank erosion.

Estimates of Existing Sediment Load

Anthropogenic fine sediment inputs are primarily a result of streambank erosion, particularly on the upper erosion inventory reach of Kirtley Creek and the associated streambanks of similar condition. Based on results from streambank erosion inventories on Kirtley Creek, the existing erosion rate for the upper reach is estimated at 268 tons per mile per year and 125 tons per mile per year for the lower inventory reach. When the erosion rate is extrapolated to similar stream channel conditions it is estimated that Kirtley Creek receives 1,331 tons per year adjacent to the upper erosion inventory reach and 166 tons per year adjacent to the lower reach.

The East Fork of Kirtley Creek four wheel drive trail is within 25 m of the stream over most of its approximate mile of length, from the main Kirtley Creek Road to the end of the trail. Sediment production from this trail is estimated at 23.2 tons contributed to the East Fork and it is assumed ultimately to Kirtley Creek. Additionally, the model was applied to the four wheel drive trail along the North Fork of Kirtley Creek from the main road to where it ends, 0.7 miles above. The stream along this reach is estimated to be within 25 m of the stream. Sediment production along the North Fork Kirtley Creek four wheel drive trail is estimated to be 18.6 tons per year. The main Kirtley Creek Road is estimated to be within 25 m of the stream over approximately 0.87 miles. Due to the close proximity of these roads to surface water it is assumed that they are hydrologically connected and that the sediment produced is ultimately transported to Kirtley Creek. The amount of traffic on the four wheel drive trails is assumed to be light, due to the rough nature of the roads, however, sediment continues to be produced in the absence of traffic.

Load Allocations

Using the water quality targets introduced above, sediment load allocations or sediment reductions are outlined in this section. Because the chronic sources of sediment are bank and road surface erosion, quantitative allocations are developed. These sediment load reductions are designed to meet the established water quality targets (20% instream surface fines and less than 28% depth fines). Bank erosion reductions are quantitatively linked to tons of sediment per year. An inferential link is developed to show how sediment load allocations will reduce subsurface fines. This link assumes that by reducing chronic sources of sediment there will be a decrease in instream surface and subsurface fines ultimately improving the status of beneficial uses. Table 3.5.3 shows bank and road erosion load percent reductions.

Based on existing sediment load from bank erosion on the upper and lower erosion inventory segments a 95 percent reduction is recommended. Based on estimated existing sediment load from road surface erosion a reduction of approximately 50% is recommended. Kirtley Creek streambank and road erosion load allocations are summarized in Table 3.5.3.

Table 3.5.3. Kirtley Creek bank and road erosion load allocations.

Reach	**Existing bank erosion**		**Desired bank erosion**		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
Upper	268	1331	13	67	95
Lower	125	166	6	8	95
Kirtley Rd.	16	13	8	7	49
E.Fk. Trail	27	23	14	12	50
N.Fk. Trail	33	19	17	11	44

Margin of Safety

The MOS factored in for Kirtley Creek load allocations are implicit. The implicit MOS are the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include: 1) Desired bank erosion rates are representative of background conditions; 2) Cumulatively, the assumptions used in the WEPP model are conservative, and 3) Water quality targets with regard to instream surface and depth fine sediment are consistent with values measured and set by local land management agencies based on established literature values and incorporate an adequate level of fry survival to provide for stable salmonid production.

Seasonal Variation and Critical Time Periods of Sediment Loading

To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed.

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example, bank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

3.6 Sandy Creek Sediment TMDL

Watershed Description
The Sandy Creek watershed encompasses 12,641 acres of combined private, state and federally managed lands from the Continental Divide to the Lemhi River (Table 3.6.1). The Sandy Creek confluence with the Lemhi River is 12 miles southeast of Salmon. Land use along the lower reach of the creek consists of irrigated private land and grazing. The USFS manages the higher elevations and the BLM administers the land between USFS and private land. To the north lies the Pratt Creek watershed and to the south, the Kenney Creek watershed.

Table 3.6.1. Land ownership within the Sandy Creek watershed.

Sandy Creek	Total	BLM	USFS	State	Private
Watershed Acres	12,641	4,168	3,464	276	4,734
Mainstem Stream Miles	6.9	1.0	1.3	0.0	4.6
Watershed Stream Miles	11.3	2.2	3.2	0.0	5.9
Percent Watershed Acres	100%	33.0%	27.4%	2.2%	37.4%
Percent Watershed Stream Miles	100%	19.3%	26.7%	0.0%	54.0%

A detailed summary of the Sandy Creek watershed is provided in the Lemhi River Subbasin Assessment (IDEQ 1998). Table 3.6.2 summarizes the watershed geomorphic characteristics. The topography varies from flat riverine near the mouth of Sandy Creek up through steeper hill country to near mountainous along the USFS boundary. Elevations range from 4,600 feet at the mouth, to 9,909 feet at the Goldstone Mountain near the Continental Divide. Steep slopes are common with 20% to 30% of the watershed exceeding 40% slope. Figure 3.6.2 shows the gradient profile for Sandy Creek from its confluence with the Lemhi to an elevation of 7,000 feet above sea level. BURP sample sites and erosion inventory sites are also shown in the gradient profile of Sandy Creek.

Table 3.6.2. Sandy Creek watershed geomorphic characteristics.

drainage area (square miles)	19.8
drainage density	0.6
maximum elevation (ft)	9,909
minimum elevation (ft)	4,600
relief ratio	0.146
total road length (miles)	36.5
road density (miles/square mile)	1.8

This TMDL addresses sediment loading on Sandy Creek. Sandy Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. At the lower BURP site the presence of aquatic plants (described as watercress) and epiphytic algae (described as moss) were noted that could be indicative of elevated levels of nutrients (probably phosphorus). It is not felt that the plants described in the BURP survey are at nuisance levels however, and continued monitoring of nutrient levels and aquatic plants is warranted. This listing definition encompasses the lower two thirds of the creek where the effect of irrigation return water would be greatest downstream with regard to sediment and nutrients. The primary land use adjacent to the §303(d)-listed segment is grazing with irrigated agriculture.

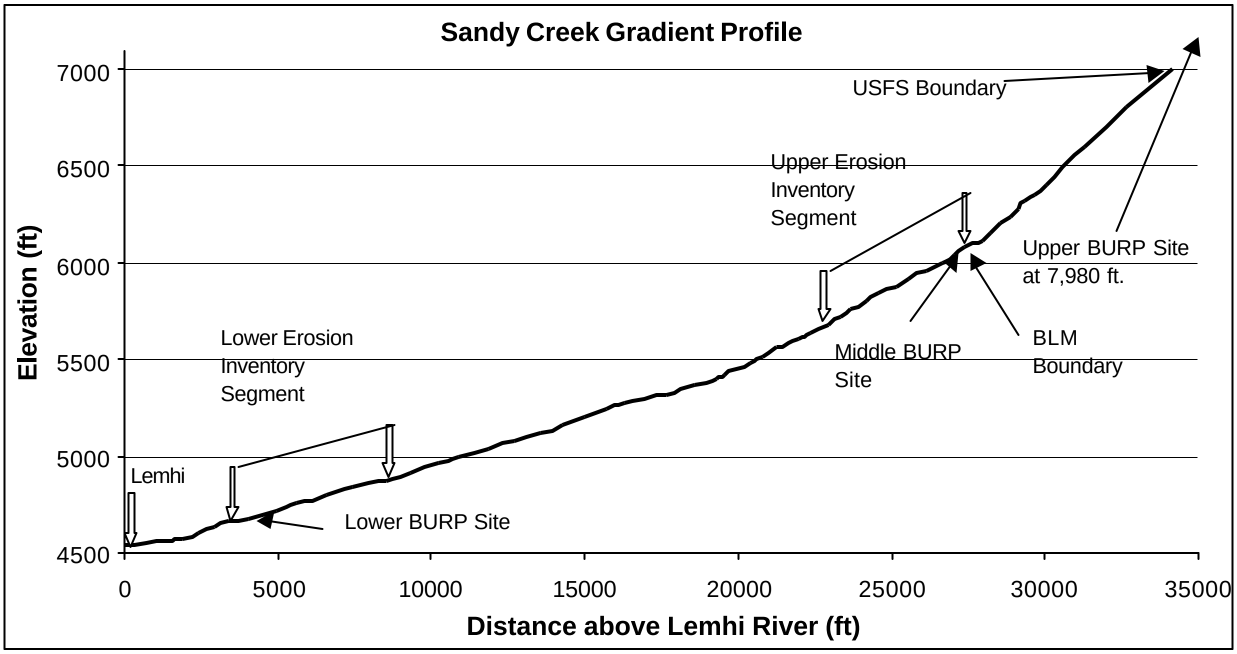


Figure 3.6.1 Sandy Creek gradient profile with relative location of sample sites (vertical exaggeration 6:1)

Beneficial Use Support Status and Pollutants of Concern

Designated beneficial uses for the listed reach include secondary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply. The listed reach on Sandy Creek has been determined to Need Verification to show full support of beneficial uses for coldwater biota and salmonid spawning based on low macroinvertebrate scores and less than 3 year-classes of same-species salmonids including young of the year (YOY). This watershed will require a TMDL to address sediment loading and to evaluate the potential for support of beneficial uses; particularly coldwater biota and salmonid spawning. Increased sediment deposition as evidenced by percent surface fines exceeds desired values and conditions.

Existing Conditions

Neither the BLM nor the USFS has established riparian monitoring sites within the Sandy Creek watershed. The IDEQ sampled water quality parameters at three sites on Sandy Creek, one on BLM and two on private property. Sampling was conducted using the BURP protocols. The upper most BURP site is just upstream from the end of the Sandy Creek road at the pack trail trailhead (T21N R24E SE1/4 SW1/4 NE1/4 of Section 35 on the Bohannon Spring Quadrangle). The next downstream site is approximately 500 m below the BLM boundary (T20N R24E SE1/4 SW1/4 NW1/4 of Section 10 on the Goldstone Mountain Quadrangle). The lowest BURP site on Sandy Creek is approximately 200 m above the old highway (T20N R24E SW1/4 NW1/4 NW1/4 of Section 19 on the Baker Quadrangle). Nutrient and temperature data were collected above and below the old highway culvert respectively. McNeil sediment core data was not collected on Sandy Creek because the lower BURP site was not considered spawning habitat, and access to an alternative site in the lower watershed was not obtainable at the time of the investigation.

Sediment analysis on Sandy Creek was done using BURP data for surface fine sediment and streambank erosion inventory data. The streambank erosion inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation characteristics developed by the NRCS as a tool to evaluate erosion condition on streambanks, gullies and roads. This process is fully described in Appendix A. In 1997, the erosion survey was conducted along two parcels of private lands covering 25.8% (1.3 miles) of the listed reach length. Streambanks along the upper reach were classified as having slight erosion potential, with an overall rating of 1 out of a potential 15. A lateral recession rate of 0.01 feet per year was determined, resulting in an estimated sediment yield of 2 tons per year for this reach. Streambanks along the lower reach were classified as having slight erosion potential, with an overall rating of 3.5 out of a potential 15. A lateral recession rate of 0.05 feet per year was determined for the lower reach, resulting in an estimated sediment yield of 3 tons per year for this reach and a corresponding estimate of 4 tons per mile per year of sediment from stream bank erosion over the sample reach. This ranks 22nd out of 28 sample reaches surveyed on 13 streams in the Lemhi watershed. Given the similar values for both reaches it is likely that either of the inventory reaches are representative of the listed segment from the BLM boundary to the old highway. The average estimate of tons of sediment contributed by stream bank erosion per mile per year for all stream sample sections was 60.1.

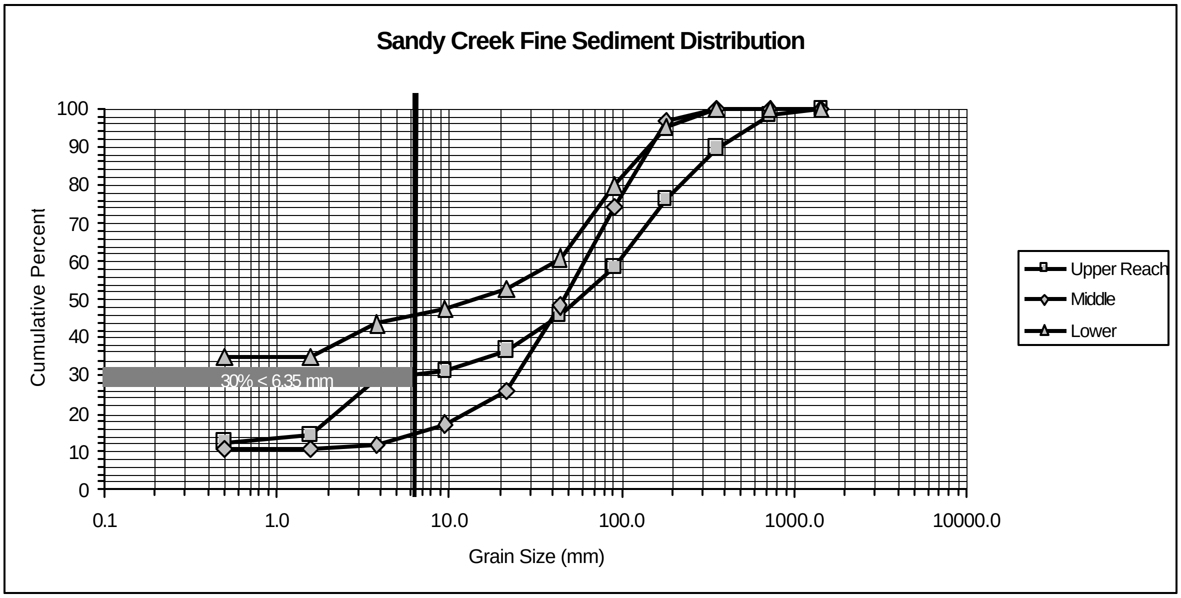


Figure 3.6.2. Surface fine sediment composition at each of the Sandy Creek BURP sites.

Aquatic insect communities sampled at the upper, middle and lower sites on Sandy Creek showed scores of 4.2, 3.0 and 4.2, respectively. Scores greater than 3.5 are indicative of non-impaired macroinvertebrate communities. The upper and lower samples score high due to the presence of macroinvertebrate species, which show a preference for high water quality. It is unclear why the middle site sample scored lower than the others. The habitat rating is well above threshold score and surface fines are lower over the middle BURP survey section. Streambank erosion is low here though the stream is braided, which could be a factor as well as the variability between sampling years.

The HI gives a score based on the natural fish habitat conditions. The upper site on Sandy Creek falls within the Northern Rockies Ecoregion. Both the middle and lower sites fall within the Snake River Basin/High Desert Ecoregion. The score of 84 at the upper site fails to meet the non-impaired threshold of a score >99, and falls into the needs verification category (IDEQ 1996). The score of 97 at the middle site meets the necessary threshold for this ecoregion (score >88), while the score of 71 at the lower site does not, and also falls into the needs verification category.

Nutrient grab samples taken in 1997 showed a total nitrogen value of 0.007 mg/l, and a total phosphorus value of 0.27 mg/l. The total nitrogen score is below the concentration recommended by Golterman (1975) of 0.3 mg/l. The score for total Phosphorus does not meet the threshold suggested by EPA (1986) of 0.1 mg/l. Aquatic plants were noted at the lower BURP site adjacent to several points where irrigation water returns to the stream channel, however they were not considered to be at or above nuisance levels. It is likely that nutrients are elevated over the lower segment of Sandy Creek, and more extensive monitoring would be required as part of the TMDL.

DEQ monitored water temperature in 1997 at the lower BURP site, just below the old highway culvert (Appendix C). The maximum daily maximum temperature from July 1 to October 30 was 68.8° F (20.4°C) which occurred with one days duration. The maximum 7-day moving average of daily maximum temperature was 66.7° F (19.4°C). Maximum daily average temperature was 62.6° F (17°C). Instantaneous surface temperature at the upper BURP site was 47.3° F (8.5°C) at 5:05 p.m. on July 18,1995. Temperatures at the monitoring site exceed State water quality standards for salmonid spawning instantaneous and maximum daily average from July 2 through August 1. The condition of the riparian vegetation over most of the stream length is in such good condition, reductions in maximum temperature would be difficult to obtain. Elevated temperatures are likely due to irrigation return water, though not in violation of State water quality standards for coldwater biota.

Water Quality Concerns

Sandy Creek is on the 1996 §303(d) list for sediment and nutrients from the BLM boundary to its confluence with the Lemhi River. This listing definition encompasses the lower two thirds of the creek. The primary land use adjacent to the 303(d) listed segment is grazing with irrigated agriculture. Land ownership along the listed segment is private. Stream temperature is elevated during July, August and September. There is evidence of elevated phosphorus levels which, combined with elevated temperature may be contributing to the exacerbation of aquatic plants over the lower segment of Sandy Creek. Aquatic plants are not felt to be present in nuisance levels at this time however. Fish sampling has not shown full support for salmonid spawning and surface fine sediment is elevated. Sandy Creek is at the threshold of full support of beneficial uses and without further degradation it may achieve full support status quickly. Future monitoring will be important to identify the course that Sandy Creek will take.

Applicable Criteria

Idaho water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states, *"Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses..."* In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state: *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."*

Load Capacities and Targets

The current state of the science does not allow specification of a sediment or nutrient load or load capacity that is known in advance to meet the narrative criteria and to fully support beneficial uses. All that can be said is that the load capacity lies somewhere between the current loading and natural background. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for Sandy Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment standards and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. Often nutrients adsorbed to sediment are reduced along with sediment reduction and as sediment sources are controlled and the temperature regime improves, it is likely that visible levels of slime growths or other elevated levels of aquatic plant growth that could potentially affect designated beneficial uses would decline.

Sediment Targets

To improve the quality of spawning substrate and rearing habitat in Sandy Creek, it is necessary to reduce the component of instream surface and subsurface fines of 6.35 mm and less to below 20 and 28 percent, respectively. A detailed discussion of subsurface fines target selection is given under Target Identification in section 2.2.

Loading Summary

Existing Sediment Sources

Streambank erosion on Sandy Creek is well below levels found on other streams in the Lemhi River watershed. Proper functioning condition assessment has been conducted on all 6.9 miles of mainstem Sandy Creek, including 4.6 miles on private land. The entire mainstem was rated as being in proper functioning condition. The West Fork of Sandy Creek (4.4 miles of mainstem) had 1.9 miles on USFS land classified as being in proper functioning condition and 1.2 and 1.3 miles of BLM and private land, respectively, was rated as functioning at risk with a static trend.

The Sandy Creek watershed has 36.5 miles of road, of which 10.6 miles (29%) is improved gravel, 6.2 miles (16.9%) is unimproved and 19.7 miles (54%) is two-track (generally 4WD trails). Road densities have been calculated at 1.8 miles per square mile. No roads in the watershed have been identified by land or transportation management agencies as being sediment producers of concern.

The mainstem base flow for Sandy Creek is approximately 5 cfs. It has only one tributary, the West Fork, which is used to power a small hydropower facility. There are 19 unscreened diversions, which greatly diminish the flow of Sandy Creek. The combined allowed total withdrawal in the watershed is 19.18 cfs from March 15 to

November 15. The overallocation of water on the stream causes it to flow intermittently along most of its length. Irrigators use water that infiltrates and then surfaces again in the stream channel. This process repeats itself along the course of Sandy Creek until, below the county road, the stream enters a slough complex in which subsurface water recharges the flow, allowing it to reach the Lemhi River. This process greatly reduces the hydraulic energy that would be available to transport fine sediment out of the watershed. The net result is likely an accumulation of fine sediment from irrigation return water and from stream bank erosion even though streambank erosion may be occurring at a lesser rate than other Lemhi River tributaries.

Estimates of Existing Sediment Loads

Sediment load to Sandy Creek was quantified using field surveys. Bank erosion was inventoried over representative reaches in the upper and lower watershed. Specifics regarding the bank erosion inventory method are described in Appendix A. Gully erosion and mass failure were not identified as significant sources of sediment in the Sandy Creek watershed. Data sheets and results are presented in Appendix B. Based on results from these inventories, the existing erosion rate ranges from 1 to 4 tons per mile per year (Table 3.6.3). Data indicate that the lower reach above the Lemhi River is eroding at a greater rate than the upper section. Streambank percent stability was above 90% at the upper and middle BURP sites where Sandy Creek is characterized as having an A channel type and 70% at the lower BURP site where Sandy Creek is in a B channel type.

Load Allocations

Using the water quality targets introduced above, sediment load allocations or sediment reductions are outlined in this section. Because the chronic sources of sediment are likely streambank erosion, quantitative load allocations are developed (Table3.6.2). These sediment load reductions are designed to meet the established water quality targets (20% surface fines and less than 28% depth fines less than 6.35 mm). Erosion of ditch banks is not quantified in this TMDL and will neewd to be evaluated as part of the TMDL for Sandy Creek. The contribution of sediment load from ditchbank erosion is identified here as a data gap that will require additional evaluation and data collection.

Table 3.6.3. Sandy Creek bank and road erosion load allocations.

Reach	**Existing bank erosion**		**Desired bank erosion**		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
Upper	1	2	1	2	0
Lower	4	3	2	2	39

Instream water quality parameters as defined by BURP data and streambank erosion inventory results do not indicate the necessity for load reductions over the upper segment of Sandy Creek, though increased sediment load should be avoided above the lower segment. Sediment load should be reduced by 39 percent over the lower erosion inventory segment in order to affect a reduction in instream surface and subsurface fines to target levels.

Margin of Safety
The MOS factored in for Sandy Creek load allocations are implicit. The implicit MOS are the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include: 1) Desired bank erosion rates are representative of background conditions; 2) Cumulatively, the assumptions used in the WEPP model are conservative; and 3) Water quality targets with regard to instream surface and depth fine sediment are consistent with values measured and set by local land management agencies based on established literature values and incorporate an adequate level of fry survival to provide for stable salmonid production.

Seasonal Variation and Critical Time Periods of Sediment Loading
To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed.

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example bank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

3.7 McDevitt Creek Sediment TMDL

Watershed Description

The McDevitt Creek watershed is located approximately 22 miles southeast of Salmon. It encompasses 14,873 acres of combined private, state, and federally managed lands (Table 3.7.1). It is bordered to the north by the Baldy Creek watershed and to the south by the Muddy Creek watershed. McDevitt Creek forms high in the Lemhi Range from a collection of springs and seeps and flows in an easterly direction to its convergence with the Lemhi River. It gains flow from the confluence of Sawmill Canyon and Mormon Canyon Creeks. Above these tributaries fisheries values are limited by low base flow. The watershed lies mostly on land managed by the BLM. Similar to the majority of the Lemhi River watershed, the land in the lower elevations is under private ownership. There are small amounts of private land encompassed by the BLM administered land.

Table 3.7.1. Land ownership within the McDevitt Creek watershed.

McDevitt Creek	Total	BLM	USFS	State	Private
Watershed Acres	14,873	12,637	0.0	1,079	1,157
Mainstem Stream Miles	10.2	6.5	0.0	1.3	2.4
Watershed Stream Miles	24.3	18.4	0.0	1.9	4.0
Percent Watershed Acres	100%	85.0%	0.0%	7.2%	7.8%
Percent Watershed Stream Miles	100%	75.7%	0.0%	7.8%	16.5%

The elevation of the watershed varies from almost 9,000 feet near the headwaters to 4,860 feet at the confluence with the Lemhi River. The lower elevations of the McDevitt Creek watershed are comprised of the valley floor and fan terraces. As the elevation increases, so does the slope of the land. The upper part of McDevitt Creek lies in a steep, forested mountain canyon while the lower section flows through more arid, sage covered foothills. Approximately 40-50% of the higher elevations, as well as the canyon that McDevitt Creek flows through, is characterized by slopes in excess of 40%. Table 3.7.2 summarizes McDevitt Creek geomorphic characteristics.

Table 3.7.2. McDevitt Creek watershed geomorphic characteristics.

drainage area (square miles)	23.4
drainage density	1
maximum elevation (ft)	9,000
minimum elevation (ft)	4,860
relief ratio	0.077
sediment deposition ratio	0.3
sediment transport potential	0.3
total road length (miles)	35.73
road density (miles/square mile)	1.5

This TMDL addresses sediment loading on McDevitt Creek. This listing definition encompasses the lower fourth of the stream. The objective of this sediment TMDL is to assess the sources and loading of anthropomorphic sediments to McDevitt Creek, determine existing conditions in the stream and determine acceptable sediment levels for which the stream should be managed to protect the coldwater biota and salmonid spawning beneficial uses that exist in the listed reach of McDevitt Creek.

Beneficial Use Support Status and Pollutants of Concern

This TMDL addresses beneficial use support on the segment of McDevitt Creek listed in the 1998 proposed §303(d) list from the BLM boundary to the Lemhi River. This equates to approximately 2 miles of actual stream, as approximately 2 miles below the BLM boundary, McDevitt Creek is dewatered for most of the year for surface irrigation and livestock watering. The dewatering of this reach eliminates any particular fisheries value, removes the mechanisms of streambank recovery and eliminates the potential for sediment delivery to the Lemhi River except under the most extreme runoff and storm events. There may be some potential to identify voluntary and cooperative irrigation efficiency projects in the future to provide some stream flow over the dewatered segment of lower McDevitt Creek that is listed, however such agreements could not be governed or enforced by a TMDL or implementation plan.

Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply. Because this segment of McDevitt Creek was on the 1996 §303(d) list for sediment, and BURP analysis that represents the lowest segment resulted in Needs Verification status for beneficial use support, it was brought forward to the 1998 proposed §303(d) list. Site status from the headwaters to the BLM boundary was assessed at full support of designated and existing beneficial uses. The lower BURP site was not assessed because the stream channel has been dry, which is the case much of the year. Figure 3.7.1 shows the gradient profile for McDevitt Creek and associated sample sites.

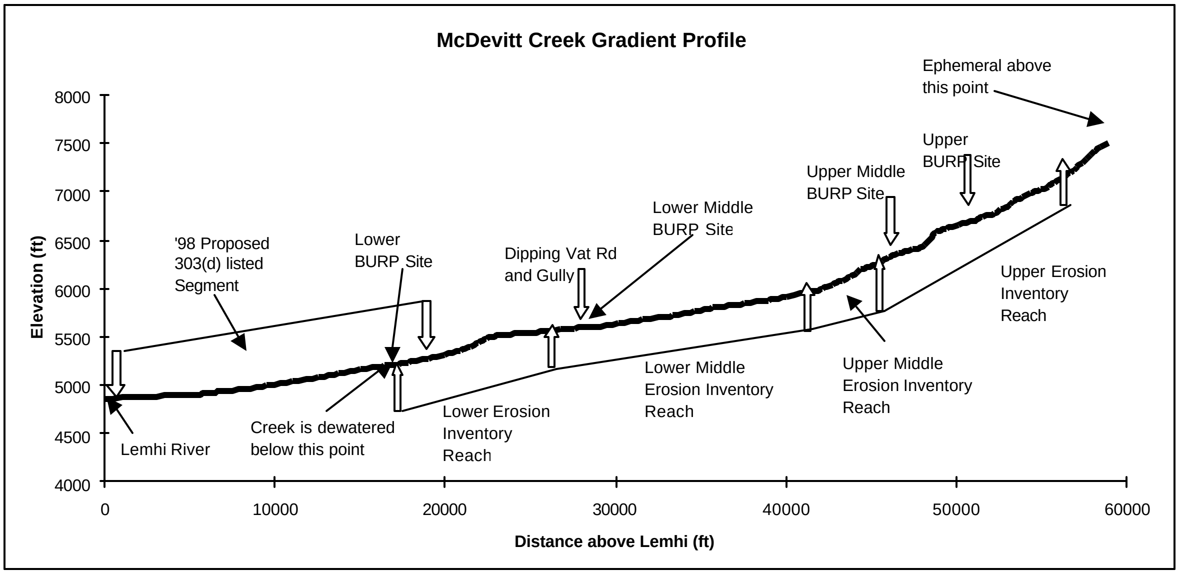


Figure 3.7.1 McDevitt Creek gradient profile with associated sample sites and boundaries (vertical exaggeration 6:1).

Existing Conditions

Due to the terracing of the canyon bottom, short sections of higher gradient channels (41% of the stream length exceeds 10% gradient) and longer sections of lower gradient channels occur in McDevitt Creek. The higher gradient channels are classified as B3 channels, while the lower gradient channels are classified as C3 channels. The McDevitt Creek watershed shows impacts from agricultural use on the private land, as well as livestock impact occurring on both private and federally managed land. The mainstem flow of McDevitt Creek on July 28, 1993 was 2.5 cfs. McDevitt Creek only reaches the Lemhi River in the spring, and then only after flowing through ditches and ponds.

Water quantity in the McDevitt Creek watershed is severely limited due to dewatering for irrigation purposes. There are seven claims to the water in McDevitt Creek, totaling 9.7 cfs. Four claims (8.56 cfs) are for the period of March 15 through November 15, one claim (1.06 cfs) is for the period April 15 to October 15, and there are two year-round claims totaling 0.08 cfs. This water withdrawal prevents McDevitt Creek from reaching the Lemhi River.

The IDEQ sampled water quality parameters at four sites on McDevitt Creek. A fifth site was attempted but could not be sampled due to dewatering of the stream channel. Sampling was conducted using the BURP protocols. The uppermost BURP evaluation site is 1/3 mile above private land approximately 3/4 mile below where McDevitt Creek leaves the road (T19N R 23E NW1/4 SW1/4 NE1/4 of Section 30 on the Poison Peak Quadrangle). The next downstream site is approximately 100 m above the 2nd road crossing (T19N R23E SW1/4 SE1/4 NE1/4 of Section 31 on the Poison Peak Quadrangle). The next downstream site is just below Dipping Vat Road (T18N R23E SE1/4 NW1/4 NE1/4 of Section 3 on the Tendoy Quadrangle). The most downstream BURP site is 0.2 miles above private property above the lower opening of the canyon (T19N R23E NW1/4 NW1/4 SE1/4 Fof Section 36 on the Tendoy Quadrangle.

Sediment analysis included McNeil core sampling, Wolman pebble counts and a streambank erosion inventory. The McNeil sampling data evaluates subsurface fines to a depth of 4 in for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fines less than 0.25 in (6.35 mm). The mean % fines including substrate 2.5 in (63.5 mm) and greater was 44.5%, with a standard deviation of 2.1. Figure 3.7.2 shows surface fine particle composition generally increasing downstream. The upper BURP site had surface fine sediment composition less than 6.35 mm (0.25 in) of 38 percent. The upper middle, lower middle and lower BURP sites were evaluated at 5%, 68%, and 48% respectively.

Aquatic insect communities sampled at the upper, upper-middle, lower-middle and lower sites showed scores of 4.0, 5.2, 3.6, and 4.2, respectively. Scores greater than 3.5 are indicative of non-impaired macroinvertebrate communities. The samples score high due to the presence of macroinvertebrate species, which require cold water to survive.

The HI gives a score based on the natural fish habitat conditions. The upper two sites fall within the Northern Rockies Ecoregion. The score of 96 at the uppermost site fails to met the non-impaired threshold score of 99, and falls into the needs verification category (IDEQ 1996), while the score of 105 at the upper-middle site indicates non-impaired conditions. Both the lower-middle and lower sites fall within the Snake River Basin/High Desert Ecoregion. The score of 91 at the lower-middle site meets the required threshold score of 88, indicating non-impaired conditions. The score of 82 at the lower site, on the private/state land border, fails to meet the non-impaired threshold score, likely due to dewatering, and the proximity of the McDevitt Creek Road over segments of the reach. This reach falls into the needs verification category.

Nutrient grab samples collected in August 1997 showed a total nitrogen value of 0.07 mg/l, and a total phosphorus value of 0.09 mg/l. The total nitrogen level is below the threshold of 0.3 mg/l recommended by Golterman (1975). The value for total phosphorus is just below the threshold of 0.1 mg/l recommended by EPA (1986).
Filamentous blue green algae were observed at the nutrient sample site at the lower mouth of the canyon. The sample site was above any significant irrigation water returns and suggests that nutrient loading may be from other sources including sediment. This condition appears to be localized and is likely related to the pooling of water above the irrigation diversion and low flow. It is expected that nutrient levels will decrease with decreased stream bank erosion and improved riparian management, thus no specific allocation for nutrients is being proposed for McDevitt Creek.

The BLM has maintained a water temperature monitoring station on the State section along lower McDevitt Creek since 1994. The maximum temperature over the past four years has averaged 61.0° F (16.1° C) in 1994, ranging from 63.0° F (17.2° C) in 1994 to 59.6° F (15.3° C) in 1997, with a generally downward trend each year. The seven-day average maximum has also shown a generally downward trend, with an average of 60° F (15.6° C) over the past four years.

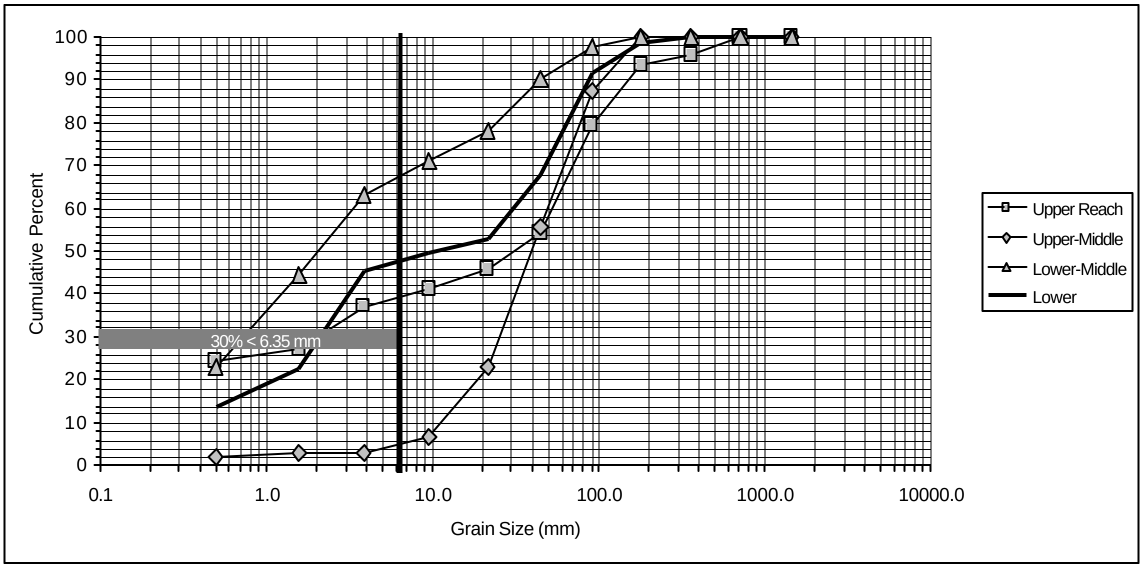


Figure 3.7.2 Surface fine sediment composition at each of the McDevitt Creek BURP sites.

In 1997, a site was also established above the upstream-most parcel of private land. The maximum temperature at this site was 49.7° F (9.8° C), thus an increase of 9.9° F over the approximately six miles between the two sites. The temperature profile at the lower site shows marked daily fluctuations, indicative of significant exposed water surface area, and thus inadequate riparian vegetation.

The McDevitt Creek watershed is known to support populations of westslope cutthroat, and rainbow trout. Due to the current dewatering of the stream it is impossible for fish to migrate between the Lemhi River and McDevitt Creek. McDevitt Creek may have been used historically by the Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*) for spawning and rearing. The Lemhi River is the nearest occupied habitat for salmon. There is no record of fish stocking in the watershed.

IDEQ sampled fish in 1997, using electrofishing gear over a 100 m transect in one pass. The transect was located at the lower middle BURP site. Five rainbow trout were collected in two age classes and five sculpin were collected. No young of the year salmonids were collected.

The BLM has established riparian vegetation monitoring sites at two locations within the watershed. Monitoring has been conducted at these sites since 1993, and consists of greenline composition, stubble heights, and photographs. Color infrared photographs were obtained and a detailed riparian inventory was conducted in 1995 to help evaluate conditions and determine valid objectives for mainstem McDevitt Creek. Hydric (riparian) vegetation from 1993 to 1997 has increased from 29% to 44% at the upper site (confluence of Mormon Canyon and McDevitt Creek) and from 37% to 56% at the lower site (just below Dipping Vat Crossing). The 1995 riparian inventory showed 4.69 miles (72%) of mainstem McDevitt Creek had >65% stable banks. The remaining 1.82 miles

(28%) range from 35-64% stable banks. Photographs of before and after management changes show much more stable stream banks and increased vegetative cover. There are also three sites set up for taking nested frequency information for evaluating trends in upland health in the watershed.

Water Quality Concerns

The primary water quality concern is related to subsurface and surface fine sediment deposited within the stream. Surface and subsurface fine sediment is above desired levels. There is no recent fish sampling data to show full support for salmonid spawning in McDevitt Creek and it is likely that there is a relationship between elevated fine sediment composition of the substrate and success of spawning fish. Contributing factors could be unscreened irrigation diversions and reduced stream flow that limits the ability of the stream to move fine sediment. It is also possible that other habitat components important to rearing fish are reduced or absent over the listed reach.

Rainbow and westslope cutthroat trout are documented to be present in McDevitt Creek. Westslope cutthroat trout have been petitioned for listing under the Endangered Species Act. It is evident that there is successful spawning activity occurring in the McDevitt Creek watershed. This is shown by the presence of salmonids, particularly cutthroat trout, despite the lack of connectivity with the Lemhi River. There is no documentation of present or historical planting of salmonids in the watershed. Salmonid spawning is likely fully supported in the middle to upper watershed, but could be extended downstream with a reduction in surface and subsurface fine sediment. This would reduce the increased risks of effect to the fish population from catastrophic natural events, which is elevated by the lack of connectivity with the Lemhi River.

Applicable Criteria

Idaho water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states, *"Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses..."* In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state, *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."*

Load Capacities and Targets

The current state of the science does not allow specification of a sediment load or load capacity that is known in advance to meet the narrative criteria for sediment and to fully support beneficial uses for coldwater biota and salmonid spawning. All that can be said is that the load capacity lies somewhere between the current loading and natural background levels. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates. Therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for McDevitt Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment standards and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background. Existing anthropomorphic sediment sources are identified and the opportunity exists through implementation of BMPs to gain significant reductions in sediment load.

Sediment Target

To improve the quality of spawning substrate in McDevitt Creek, it is necessary to reduce the component of subsurface fines of 6.35 mm and less to below 28 percent. It is necessary to reduce the component of instream surface fines of 6.35 percent and less to below 20 percent. A detailed discussion of subsurface fines target selection is given under Target Identification in Section 2.2.

Loading Summary

Existing Sediment Sources

The McDevitt Creek watershed is characterized by very steep canyon walls with erosive soils and it likely has a higher natural sediment yield than other comparable sub-watersheds in the Lemhi River subbasin. This necessitates comprehensive grazing management, diligent road maintenance and protection of the riparian zone to maintain fisheries habitat and water quality. Streambank erosion is responding well to improved riparian and grazing management. Land management agencies have recently initiated practices to effect the improvement of riparian and fisheries habitat and water quality in McDevitt Creek. Private land owners above the listed segment have shown interest in improved grazing management and riparian habitat management also.

Significant sediment sources above the listed segment of McDevitt Creek include streambank erosion, the McDevitt-Haynes Loop Road and the Dipping Vat Road. Dipping Vat Road has the potential to deliver extreme quantities of sediment to McDevitt Creek under significant runoff or precipitation events because of the large gully that has formed beside the road. It will be necessary to implement BMPs to arrest further gully erosion, to stabilize the gully and to prevent delivery to McDevitt Creek. The McDevitt-Haynes Loop Road will benefit from cross-bar implementation, regular maintenance and outslope drainage where gradient and proximity to McDevitt Creek determine the necessity through the road evaluation program being conducted by BLM. BLM has identified the need to evaluate these roads prior to the subbasin assessment and the writing of this TMDL.

Sediment sources above the listed segment are being addressed through improved riparian and grazing management and a comprehensive road management plan with evaluation of particular roads for closure. Of the 10.2 miles of McDevitt Creek assessed by BLM under Proper Functioning Condition protocol immediately above and including the listed segment, 4.5 miles on BLM land and 1.3 miles on State land has been assessed as being in proper functioning condition. Two miles of BLM managed stream assessed as functional at risk with an upward trend. On private land, 1.7 miles were assessed to be functional at risk with no trend determination and 0.7 miles of the listed segment were shown to be dewatered at the time of the assessment. Tributaries to McDevitt Creek, Mormon Canyon and Sawmill Canyon Creeks, were assessed to be in proper functioning condition.

Estimates of Existing Sediment Loads

Sediment load to McDevitt Creek was quantified using field surveys. Bank erosion was inventoried over representative reaches in upper, middle and lower McDevitt Creek. Specific methodology regarding the streambank erosion inventory are described in Appendix A. The amount of sediment from gully erosion from the Dipping Vat Road gully was quantified using field surveys similar to the stream bank erosion inventory method.

Streambank erosion inventories were conducted over 3 reaches on McDevitt Creek. An upper reach extended from above the confluence of Sawmill Creek to a point near the headwaters where the McDevitt Creek Road leaves the canyon. The middle reach was from the lower point of the upper reach to the BLM/state land boundary and the lower reach was from the BLM/state land boundary downstream to the state/private land boundary where the stream is dewatered. Based on results from these inventories, the existing erosion rate ranges from 1 to 53 tons per mile per year (Table 18). Data indicate that the lowest stream bank erosion rate occurs over the lower listed segment of McDevitt Creek.

The gully erosion field survey conducted on the Dipping Vat Road gully shows a total annual erosion rate of 545 tons. This is the largest potential source of sediment to McDevitt Creek, though delivery to McDevitt Creek is situational and related to heavy precipitation and runoff events. Delivery to McDevitt Creek is not constant but sediment that accumulates between events is likely contributed to McDevitt Creek in high percentage associated with the more extreme precipitation events that occur with a five-year frequency.

Load Allocations

Using the water quality targets described in Section 2.2, sediment load allocations have been outlined for McDevitt Creek. Quantitative load allocations have been developed to address the chronic sources of sediment to McDevitt Creek, particularly bank and gully erosion. These sediment load reductions are designed to meet the established water quality targets described in Section 2.2 (less than 28% depth fines less than 6.35 mm and less than 20% instream surface fines less than 6.35 mm). Bank erosion reductions are quantitatively linked to the instream sediment targets. An inferential link is developed to show how sediment load allocations will reduce subsurface fines. This link assumes that by reducing chronic sources of sediment there will be a decrease in subsurface fines.

Based on the existing sediment load from bank erosion field data a 13 percent and 94 percent reduction of stream bank erosion rate is required (Table 3.7.3). Also a 100 percent reduction of sediment contribution from the Dipping Vat Road gully will be required.

Table 3.7.3. McDevitt Creek bank erosion load allocations.

Reach	Existing bank erosion		Desired bank erosion		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
Upper	23.7	79.7	20.6	69.1	13
Middle	52.9	42.8	3.0	2.4	94
Lower	1	0.06	0.5	0.03	54

The McDevitt-Haynes Loop Road is also a potential source of sediment to McDevitt Creek. Rather than developing a quantitative load reduction, this TMDL suggests reducing the sediment contribution by implementing adequate BMPs such as cross bar drainage, out-slope drainage, regular maintenance and culvert armoring to affect minimal road erosion. Continued evaluation of roads for closure is also recommended.

Margin of Safety

Implicit and explicit MOS are factored into this TMDL. The implicit MOS is the conservative assumptions used to develop sediment targets and loads and include: 1) multiple water quality targets; 2) the link between bank and gully erosion and level of instream surface and subsurface fines; and 3) assumptions made in the bank and gully erosion estimates.

The assumptions made for the gully erosion estimates are: 1) use a bulk density value of 90 pounds per cubic foot (pcf), and assume it is the same for all gullies; 2) the needed reduction of management related gullies is 100 percent; and 3) removing triggering mechanisms will eventually lead to stabilization.

The subsurface fines target of 28 percent is consistent with values measured and set by local land management agencies based on established literature values and incorporates an adequate level of fry survival to provide for a stable salmonid population.

Seasonal Variation and Critical Time Periods of Sediment Loading

To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed.

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage, most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example, bank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

3.8 Wimpey Creek Sediment TMDL

Watershed Description

The Wimpey Creek watershed encompasses 13,806 acres of combined private, state, and federally managed lands (Table 3.8.1). The watershed is located approximately 11 miles east of Salmon. The watershed is bordered to the west by the Bohannon Creek watershed and to the east by the Pratt Creek watershed. As with the other watersheds in the Lemhi River watershed, the higher elevations are administered by the USFS and the lower portions of the watershed are under private ownership. The BLM administers the land that lies between the USFS and private.

Table 3.8.1. Land ownership within the Wimpey Creek watershed.

Wimpey Creek	Total	BLM	USFS	State	Private
Watershed Acres	13,806	6,628	3,849	894	2,434
Mainstem Stream Miles	8.7	3.3	2.1	0.0	3.3
Watershed Stream Miles	19.8	9.4	4.8	1.2	4.4
Percent Watershed Acres	100%	48.0%	27.9%	6.5%	17.6%
Percent Watershed Stream Miles	100%	47.5%	24.2%	6.1%	22.2%

Table 3.8.2 summarizes the watershed's geomorphic characteristics. The elevation of the watershed varies from heights in excess of 10,000 feet along the Continental Divide to approximately 4,360 feet where Wimpey Creek joins the Lemhi River.

Table 3.8.2. Wimpey Creek watershed geomorphic characteristics.

drainage area (square miles)	21.6
drainage density	0.9
maximum elevation (ft)	10,000
minimum elevation (ft)	4,360
relief ratio	0.123
sediment deposition ratio	0.2
sediment transport potential	0.7
total road length (miles)	24.12
road density (miles/square mile)	1.1

This TMDL addresses sediment loading on Wimpey Creek. This listing definition encompasses the lower third of the stream (Figure 3.8.1). The primary land uses adjacent to the listed segment are grazing, irrigated agriculture, residential development and transportation. Land ownership along the listed segment is private. The object of this sediment TMDL is to assess the anthropomorphic sources and loading of sediments to Wimpey Creek, determine existing conditions in the stream and determine acceptable sediment levels for which the stream should be managed to protect existing and designated beneficial uses.

Beneficial Use Support Status and Pollutants of Concern
Designated beneficial uses for the listed reach include primary contact recreation, industrial water supply, wildlife habitat, and aesthetics. Existing beneficial uses include coldwater biota, salmonid spawning and agricultural water supply. This stream is listed for sediment and nutrients on the Idaho 1996 §303 (d) list. The listed reach on Wimpey Creek has been determined to Need Verification to show full support of beneficial uses. Increased turbidity levels and sediment deposition, as evidenced by percent

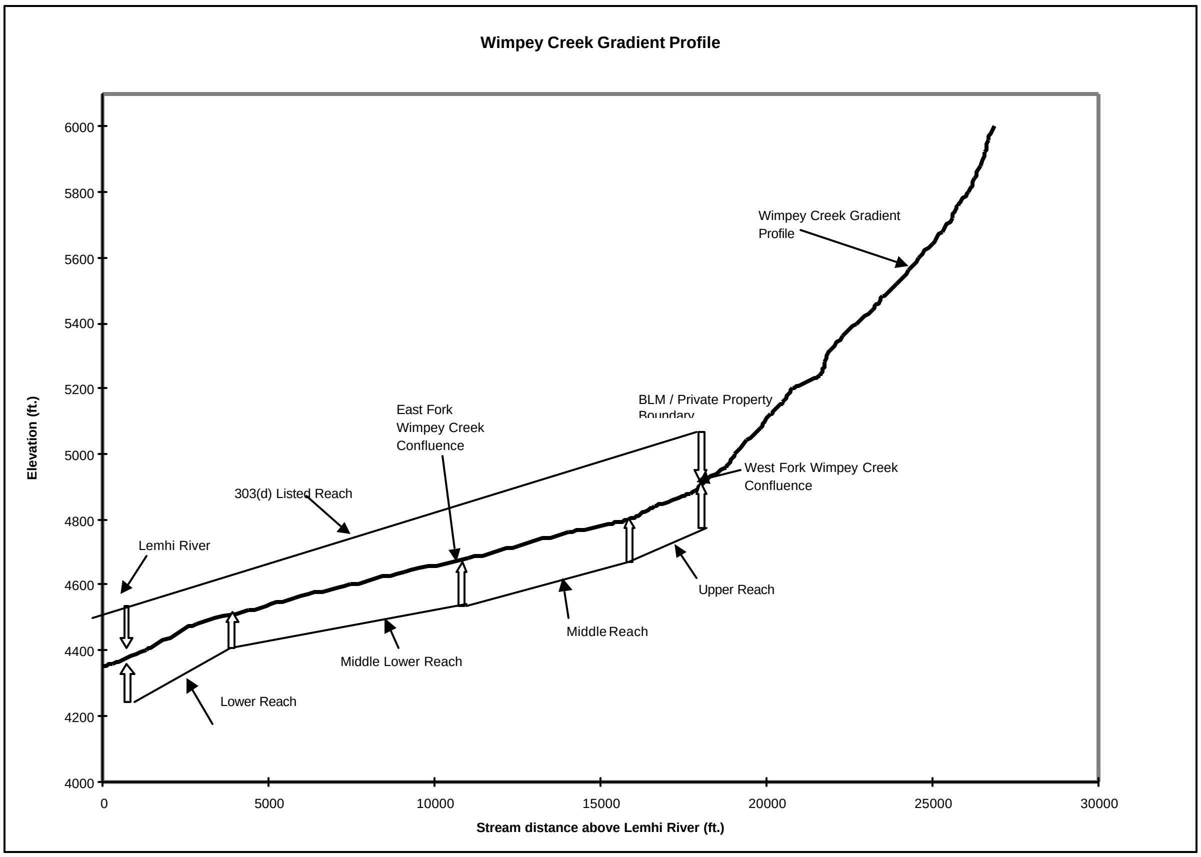


Figure 3.8.1 Wimpey Creek gradient profile and associated sample locations (vertical exaggeration 10:1)

instream surface and subsurface fines and statements from adjacent residents regarding the frequent increased turbidity, exceeds desired values and conditions. There are multiple large side gullies that contribute significant quantities of sediment to the creek, just above the East Fork of Wimpey Creek confluence, that have evolved from localized flood irrigation and ditch failure. This watershed will require a TMDL to address sediment loading and potential for support of beneficial uses.

Existing Conditions
The BLM has one temperature monitoring site in the watershed. There are no established riparian monitoring sites within the watershed, due to the limited riparian habitat issues on the land managed by BLM and USFS.

The IDEQ sampled water quality parameters at three sites in the Wimpey Creek watershed, one on the West Fork, one on the East Fork, and one on the mainstem. Sampling was conducted using the BURP protocols. The East Fork Wimpey Creek BURP site is located 0.8 miles above the confluence of the East Fork with main Wimpey Creek (T21N R23E SE1/4 NE1/4 SE1/4 of Section 25 on the Baker Quadrangle). The West Fork Wimpey Creek site is just upstream from the cabin located 4.6 stream miles above the confluence of the West Fork with main Wimpey Creek (T21N R 24E SE1/4 NE1/4 SE1/4 of Section 25 on the Bohannon Spring Quadrangle). The main Wimpey Creek site is 0.6 miles above the confluence of Wimpey Creek with the Lemhi River, approximately 100 m above the Skinner ranch house (T21N R23E NE1/4 SE1/4 SE1/4 of Section 34 on the Baker Quadrangle). McNeil sediment core samples and nutrient samples were collected just above the old highway culvert just below the lower BURP site. Temperature monitoring was conducted at the lower section of the BURP survey section on the East Fork of Wimpey Creek and on the mainstem just above the East Fork confluence. Streambank erosion inventory was conducted from the BLM boundary to just above the confluence of the East Fork of Wimpey Creek on main Wimpey Creek.

Sediment analysis included McNeil core sampling, instream surface fine sediment sampling and streambank erosion inventory that included evaluation of lateral gullies. The McNeil sampling data evaluates subsurface fines to a depth of 4 in for resident fish species, and indicates expected fry survival as it relates to percentage of intragravel fines less than 0.25 in (6.35 mm). The mean % fines including substrate 2.5 in (63.5 mm) and greater was 14.9%, with a standard deviation of 4.0. The mean % fines, not including substrate 2.5 in (63.5 mm) and greater, was 29.8%, with a standard deviation of 7.1. The mean % fines less than 0.85 mm (0.03 in) including substrate 2.5 in (63.5 mm) and greater was 2.2%. The mean % fines less than 0.85 mm not including substrate 2.5 in (63.5 mm) and greater was 4.3%. Wolman pebble counts show 45% of surface particles less than 0.25 in (6.35 mm) at the main Wimpey Creek BURP site, 22% at the East Fork site and 53% at the West Fork site.

The Streambank erosion inventory is a qualitative evaluation of channel shape, bank stability and riparian vegetation used by the NRCS as a tool to evaluate erosion condition on stream banks, gullies and roads (Appendix A). In 1997, a survey was conducted at two reaches on private lands along 33% (1.2 miles) of the listed reach length. Streambanks along the upper reach were classified as having a moderate erosion potential, with an overall rating of 5 out of a potential 15. A lateral recession rate of 0.06 feet per year was determined, resulting in an estimated sediment yield of 1 tons per year for this reach and a corresponding estimate of 5 tons per mile of sediment from streambank erosion over the sample reach. This segment ranks 19th out of 28 sample reaches surveyed in the Lemhi watershed. The average estimate of tons of sediment contributed by streambank erosion per mile for all stream sample sections was 60 tons per mile per year.

Streambanks along the lower reach were classified as having severe erosion potential, with an overall rating of 10 out of a potential 15. A lateral recession rate of 0.5 feet per year was determined, resulting in an estimated sediment yield of 9 tons per year for this reach and a corresponding estimate of 60 tons per mile of sediment from stream bank erosion over the sample reach. This reach ranks 10th out of 28 sample reaches surveyed.

The runoff from snowmelt in the spring of 1997 resulted in the highest flows the landowner of this property has seen in over 25 years, and he states that the effect on stream banks was severe. Another compounding factor for extreme sediment production over this reach is multiple large side gullies that have resulted from flood irrigation. Nine gullies associated with the lower erosion inventory were evaluated. The gullies averaged 184 feet long by 35 feet wide with an average volume of 70,956 cubic feet. Water from flood irrigation return has increased the size of the gullies over time in conjunction with snow melt. Residents downstream of this site report frequent severe turbidity with several days' duration when flood irrigation occurs on this pasture. Large plumes of coarse sediment occur just below several gullies. These deposits were measured up to 30 feet in length by 20 feet wide with undetermined depth. Stream conditions below this point exhibit very high percentage fines of sizes predominantly less than 1/4 inch and associated stream channel aggradation. Further investigation downstream of this site would be required to determine the magnitude of the effect this level of erosion is having on Wimpey Creek.

Aquatic insect communities sampled at the East Fork, West Fork, and mainstem of Wimpey Creek showed scores of 6.2, 4.6 and 3.4, respectively. Scores greater than 3.5 are indicative of non-impaired macro invertebrate communities. The samples for the East Fork and West Fork score high due to the presence of macro invertebrate species, which have a presence for high water quality.

The HI gives a score based on the natural fish habitat conditions. Both the East Fork and mainstem sites fall within the Snake River Basin/High Desert Ecoregion. The scores of 86 at the East Fork site and 70 at the mainstem site fails to meet the non-impaired threshold of a score >88, and falls into the needs verification category. The West Fork site falls within the Northern Rockies Ecoregion, and the score of 111 exceeds the required 99, indicating non-impaired conditions.

Nutrient grab samples taken in 1997 showed a total nitrogen value of 0.04 mg/l, and a total phosphorus value of 0.21 mg/l. The total nitrogen is below the concentration recommended by Golterman (1975) of 0.3 mg/l. Phosphorus value exceeds the EPA suggested threshold. The value for total phosphorus exceeds the EPA suggested threshold of 0.1 mg/l (EPA 1986). At the lower BURP evaluation site it was noted that much of the substrate was covered with epiphytic cladophora. This condition increases downstream to the confluence with the Lemhi River. There is a significant amount of irrigation water return over the lower portion of Wimpey Creek that likely increases the nutrient load. At this time, it is not felt that epiphytic algal growth has reached nuisance levels though further monitoring is needed to determine the trend.

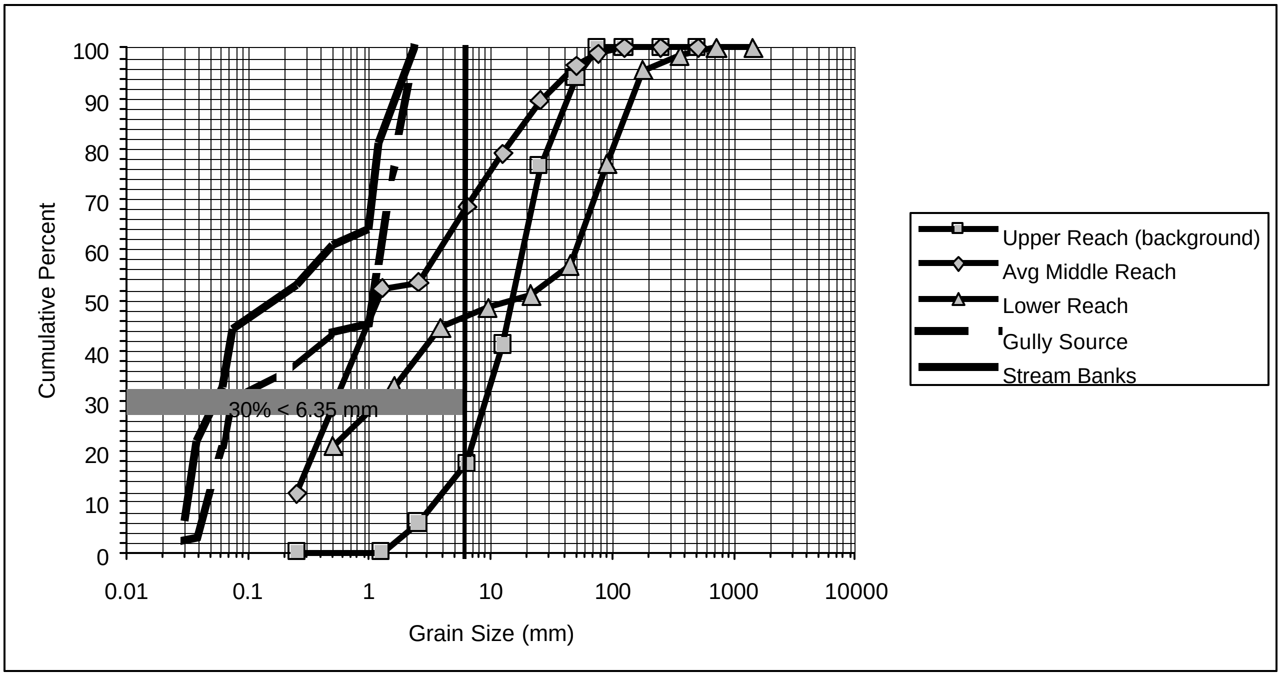


Figure 3.8.2 Wimpey Creek surface fine sediment composition associated with BURP sites

The BLM monitored water temperatures in the West Fork of Wimpey Creek in 1997. The maximum daily average water temperature was 53.9^0 F, with a seven day maximum average of 52.8° F (11.6° C). DEQ monitored water temperature just below the BURP site on the East Fork Wimpey Creek from July 1 through October 30, 1997 at hourly intervals. The average of daily maximum temperature was 61.9° F (16.6°C). The 7 day moving average of daily maximum temperatures was 65.8° F (18.8° C). From mid August through October 1998 stream temperature was monitored on main Wimpey Creek at two locations. Just above the confluence of the East Fork Wimpey Creek and just above the confluence of main Wimpey Creek with the Lemhi River. Stream temperature was found to be within state water quality standards from August 18 through October 7 for coldwater biota, however, there are minor violations of state water temperature criteria for salmonid spawning for cutthroat as evidenced by daily maximum and daily average temperature on August 18, 1998. Temperature monitoring of the West Fork Wimpey Creek shows that it is within state water quality standards. The East Fork Wimpey Creek temperature regime is above state water quality standards for salmonid spawning from July 3 through August 1 for cutthroat with regard to instantaneous maximum and maximum daily average temperature. Elevated temperatures are due to extremely low flow during this period due to irrigation.

Fish sampling over the lower segment of Wimpey Creek, below the East Fork Wimpey Creek confluence, shows the presence of rainbow trout. There is some anecdotal information to indicate a potential that bull trout are present in the upper watershed. Bull trout, however, have not been confirmed in the West Fork, upper mainstem or East Fork Wimpey Creek. Natural reproduction of rainbow trout is likely occurring in the West Fork Wimpey Creek, and would be important to maintaining the watershed population of fish below the BLM boundary, however irrigation diversions at two locations below the West Fork Wimpey Creek constitute fish barriers. These diversions limit access to the West Fork for fish migrating from the Lemhi River, or non-migratory fish present below the confluence of the East Fork Wimpey Creek. The unscreened diversions would also be a source of mortality for migrating fry.

Water Quality Concerns

Wimpey Creek water quality is most severely impacted by anthropomorphic sediment. The watershed is very steep with erosive soils and likely has a higher natural sediment yield than other watersheds in the Lemhi River subbasin. Intensive grazing and irrigation management practices have accelerated localized erosion above the East Fork Wimpey Creek. Wimpey Creek road has been identified as a source of sediment to the mainstem of Wimpey Creek, particularly adjacent to the confluence of the East Fork. It is apparent that the culvert here fails periodically from intermittent heavy runoff that originates in the side drainage to the west. Additionally, surface erosion occurs at several locations within ¼ mile below the East Fork.

Evaluation of sediment deposition characteristics within the stream and of erosion characteristics of stream banks show instream surface fines moderately above target threshold at the BURP site on the East Fork Wimpey Creek and above the confluence of the East Fork on the mainstem. Surface fines at the sites on the West Fork and the lower reach of mainstem Wimpey Creek just above the confluence with the Lemhi River are within target range. Streambank erosion inventories show slightly below average values on the upper inventory site on Wimpey Creek above the East Fork confluence compared to other sites in the Lemhi River watershed.

There is localized excessive sediment deposition just above the East Fork confluence that results in elevated surface and sub-surface fine sediment composition. Stream bank erosion at the lower erosion inventory site is about average for other streams surveyed in the Lemhi River subbasin.

Sediment transport in Wimpey Creek is not adequate as evidenced by channel aggradation below side gullies. Eventually these instream deposits will impact lower reaches. Turbidity increases associated with pasture flood irrigation need further evaluation to determine the cumulative effect on aquatic biota. The frequency and duration of these events could be significant.

Habitat and macroinvertebrate scores reflect a perturbed system, as do elevated surface fines and reduced stream bank stability ratings. Overall, streambanks did not tolerate the high runoff in the spring of 1977 very well. Large areas of banks on the upper mainstem below BLM land were significantly impacted by flows. According to the property owner there, flows were the highest he has seen in over 25 years. Large cobbles and boulders were moved out of the upper canyon and deposited where the stream channel widens below. Trees are being undermined and down cutting below the diversion structures are evident.

Nutrient loading is also likely naturally elevated due to erosive conditions here, however irrigation return probably further elevates nutrient levels in Wimpey Creek though no exacerbation of nuisance levels of aquatic macrophytes or epiphytic algal growth has been observed. Epiphytic algal growth has been documented at the lower BURP site, just above the confluence of Wimpey Creek with the Lemhi River, but this growth could not be described as nuisance level.

Temperature monitoring of the mainstem during 1998 shows water temperature within State water quality standards for coldwater biota and salmonid spawning for rainbow trout. Unscreened irrigation diversions pose fish migration barriers, are a likely source of fish mortality and the associated ditches are a mechanism to elevate temperature of water returned to Wimpey Creek. Temperature monitoring of the upper mainstem at the BLM boundary would be useful to identify the potential for water temperatures downstream.

The condition of riparian habitat is fair over much of the listed reach with isolated degraded segments, however the upper and lower erosion inventory segments exhibit streambank and gully erosion that is impacting localized instream habitat and spawning substrate quality and threatening downstream habitat. Elevated turbidity associated with flood irrigation needs to be quantified, but appears to be at or near levels that could be affecting fish and invertebrates for several days duration at multiple times during the irrigation season. Mass wasting potential remains high at one location on the east rim of the canyon at the mouth, on the Skinner Ranch. Irrigation return flow continues to saturate the soil adjacent to the previous land slide, increasing the likelihood of slumping and an additional slide. This could potentially have catastrophic effects on the stream below this point and could affect adjacent land owners and the Lemhi River as well.

The primary water quality concern is related to subsurface fine sediment deposited within the stream substrate. Subsurface fine sediment is above desirable levels from the lower bound of the upper erosion inventory reach to just below the mouth of the canyon. Gully and streambank erosion and mass wasting, if left unchecked, would likely further degrade the capacity of the stream to sustain salmonids. There is not recent fish sampling data to show full support for salmonid spawning in Wimpey Creek and it is likely that there is a relationship between elevated subsurface fine sediment composition of the substrate and success of spawning fish. Contributing factors could be unscreened irrigation diversions, fish passage barriers and reduced stream flows that limit the ability of the stream to move fine sediment. It is also possible that other habitat components important to rearing fish are reduced or absent over the listed reach.

It is evident that there is successful spawning activity occurring in the Wimpey Creek watershed. This is shown by the presence of salmonids, particularly cutthroat trout, despite the seasonal lack of connectivity with the Lemhi River. There is no documentation of present or historical planting of salmonids in the Wimpey Creek watershed. Salmonid spawning is likely fully supported above the BLM boundary, as evidenced by the presence of native salmonids, but could be extended below the BLM boundary with a reduction in subsurface fine sediment and improvement of fish passage from the Lemhi River to waters above the BLM boundary. This would reduce the increased risks of effect to the fish population from catastrophic natural events, which is elevated by the lack of connectivity with the Lemhi River.

Applicable Criteria
Idaho water quality standards include two criteria, which relate to sediment. A narrative sediment standard is established (IDAPA 16,01.02.200.08) which states, *"Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses..."* In addition, a numeric turbidity criteria (IDAPA 16.01.01.250.02.b) is established to control water clarity. This standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

State water quality standards that relate or could be interpreted to relate to nutrients state, *"Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."*

Load Capacities and Targets
The current state of the science does not allow specification of a sediment load or load capacity that is known in advance to meet the narrative criteria and to fully support beneficial uses. All that can be said is that the load capacity lies somewhere between the current loading and natural background. We presume that beneficial uses were or would be fully supported at natural background sediment loading rates; therefore, until the relationship between beneficial use support and sediment loading is better understood, the loading capacity for sediment for Wimpey Creek will be the natural background sediment load rate.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a target of a declining trend in sediment loads, and to regularly monitor water quality and beneficial use support status. It is our intent to re-interpret the sediment standards and revise the TMDL accordingly if it is established that full support of beneficial uses is achieved at sediment loads above natural background.

Sediment Targets
To improve the quality of spawning substrate and rearing habitat in Wimpey Creek, it is necessary to reduce the component of instream surface and subsurface fines of 6.35 mm and less to below 20 and 28 percent, respectively. A detailed discussion of surface and subsurface fines target selection is given under Target Identification in section 2.2.

Loading Summary

Existing Sediment Sources

Background or natural sediment levels fluctuate in Wimpey Creek as a function of lithology and soils. A detailed summary of Wimpey Creek geology and soils is provided in the Lemhi River Subbasin Assessment. As stated in this assessment, soil groups directly above and adjacent to the impaired stream reach are highly erodible and are the major source of anthropogenic sediment inputs to the stream channel. Of the identified gullies and mass wasting features, 36 % are natural, and about 64 % of the features are related to land management. Anthropogenic fine sediment inputs are primarily a result of bank erosion, gully erosion, and mass failure.

Bank erosion occurs along the mainstem of Wimpey Creek and tends to increase in a downstream direction to the confluence of the East Fork. This is common in many semi-arid watersheds where bank erosion increases with increasing watershed area. In Wimpy Creek, bank erosion is directly associated with channel entrenchment and lack of adequate riparian plant densities and deep rooted species which provide bank stability.

Gully erosion is prevalent along the northern slope of upper Wimpy Creek. Natural gullies along the southern aspect of the valley hillslope have been active since at least 1946 and likely have been active for hundreds of years. Sediment delivery from these gullies is limited as evidenced by large alluvial fans along the valley bottom. Several gullies, triggered by land use, are delivering substantial amounts of sediment to the stream channel annually. Formation of these lateral gullies is linked to saturation of slopes below the pasture irrigation ditch upslope from the stream channel.

Below the East Fork confluence bank and gully erosion are less prevalent, however, several mass failures impact the stream channel. Based on aerial photo interpretation, 39 mass failures have occurred since 1946, and about 60 percent of these were triggered by land management practices. For example, a large shallow rotational slide was likely triggered around 1960 and resulted from saturated soils associated with irrigation. The landslide was about 300 feet wide, 675 feet long, and over 20 feet deep. The slide pushed the Wimpey Creek channel to the north edge of the canyon and likely delivered 65,000 tons of sediment to the stream or about 55 percent of the displaced volume entered the stream channel. Since 1960, the slide is progressively re-vegetating and stabilizing. Recent movement is not apparent from the aerial photos.

Estimates of Existing Sediment Loads

Sediment load to Wimpey Creek was quantified using field surveys and aerial photos. Bank erosion was inventoried over representative reaches in upper Wimpey Creek above the confluence of the East Fork. Specifics regarding the bank erosion inventory method are described in Appendix A. The amount of gully erosion and mass failure were quantified using field surveys similar to the bank erosion method and historic aerial photos.

Stream bank erosion inventories were conducted on Wimpy Creek above the East Fork confluence. Data sheets and results are presented in Appendix A. Based on results from these inventories, the existing erosion rate ranges from 5 to 60 tons per mile per year (Table 3.8.3). Data indicate that the lower reach above the East Fork Wimpey Creek confluence is eroding at a substantially greater rate than the upper section.

Gully erosion surveys were conducted on 12 active gullies (Table 3.8.3). Aerial photo analysis was used to identify active and inactive gullies from 1946 to present. Data sheets and results are presented in Appendix A. A total of 12 gullies were identified and surveyed. Historic aerial photos were used to approximate the time a given gully was triggered. Substantial quantities of sediment are being delivered to Wimpy Creek through gully erosion. The rate of management induced gully erosion has increased since 1946. For example, in 1946 only one management-induced gully is apparent from the aerial photos. Conversely, in 1998 there are at least 12 active gullies within the same watershed suggesting a 10 fold increase in gully formation. The likely cause of gully formation is linked to irrigation practices within the watershed.

Table 3.8.3. Wimpey Creek summary of sediment load from gully erosion.

Gully Number	Tons per year delivered
G-1	82
G-2	2
G-4	103
G-4a	32
G-5	189
G-6	129
G-6a	30
Misc. Small Gullies	190
Road Gully	9
Total Delivered	**766**

Mass failures are fairly common within the watershed, however, quantification of these inputs is limited. Mass failures tend to be discrete inputs of sediment and are not considered to be chronic sources like bank and gully erosion (Appendix A). A total of 7 active landslides were identified during the inventory. For example, the large landslide described above likely instantaneously input 65,000 tons of sediment into Wimpy Creek, however, present inputs are likely minimal relative to bank and gully erosion. Every effort should be made to prevent these types of features to reduce the future sediment load from mass failure. Historic accounts of landslide initiation are directly related to irrigation practices and generally involve over-saturation of erodible soils on steep slopes.

Load Allocations

Using the water quality targets introduced above, sediment load allocations or sediment reductions are outlined in this section. Because the chronic sources of sediment are bank and gully erosion, quantitative load allocations are developed. These sediment load reductions are designed to meet the established water quality targets (20% instream surface fines and less than 28% depth fines). An inferential link is developed to show how sediment load allocations will reduce subsurface fines. This link assumes that by reducing chronic sources of sediment there will be a decrease in surface and subsurface fines ultimately improving the status of beneficial uses.

Based on the existing sediment load from bank erosion, a 58 percent and 93 percent reduction of streambank erosion on the upper and lower reach is recommended (Table 3.8.4). Additionally, mitigation of existing gullies is needed and this TMDL recommends a 100 percent decrease of land use related gully formation.

Table 3.8.4. Wimpey Creek streambank erosion load allocations.

Reach	**Existing bank erosion**		**Desired bank erosion**		
	Erosion Rate (t/mi/y)	**Total Erosion (t/y)**	**Erosion Rate (t/mi/y)**	**Total Erosion (t/y)**	**Bank Erosion Rate Percent Reduction**
Upper	5	0.2	2.1	0.1	58
Middle	60	9	3.9	0.6	93
Middle-Lower	5	0.5	2.0	0.2	60
Lower	60	9	4	0.6	93

Mass failure is also likely a substantial source of sediment to Wimpey Creek. Rather than developing a quantitative load reduction, this TMDL recommends reducing the mass wasting frequency from 3 features per square mile to 1 feature per square mile or a 67 percent reduction in mass wasting frequency.

Margin of Safety

Implicit and explicit MOS are factored into this TMDL. The implicit MOS is the conservative assumptions used to develop sediment targets and loads and include: 1) multiple water quality targets; 2) the link between bank and gully erosion and level of subsurface fines;and 3) assumptions made in the bank and gully erosion estimates.

The assumptions made for the gully erosion estimates are: 1) use a bulk density value of 90 pounds per cubic foot (pcf), and assume it is the same for all gullies; 2) the needed reduction of management related gullies is 100 percent; 3) removing triggering mechanisms will eventually lead to stabilization and 4) Desired mass wasting rates are representative of natural conditions.

The subsurface fines target of 28 percent is consistent with values measured and set by local land management agencies based on established literature values and incorporate an adequate level of fry survival to provide for stable salmonid population.

The explicit MOS is factored into the sediment allocations. This analysis is unable to quantify the level of sedimentation that will provide conditions characteristic of fully supporting beneficial uses. Consequently, instream sediment load reductions are established relative to background. The load reductions and the allocation strategy use background conditions as a benchmark or baseline.

Seasonal Variation and Critical Time Periods of Sediment Loading
To qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using annual rates determined from empirical characteristics that developed over time within the influence of peak and base flow conditions. While deriving these estimates it is difficult to account for seasonal and annual variation within a particular time frame, however, the seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed..

Annual erosion and sediment delivery are greatly a function of climate where wet water years typically produce the highest sediment loads, whereas dry water years produce below average sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in the Lemhi River drainage, most streambank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff.

This sediment analysis uses empirically derived hydrologic concepts to help account for variation and critical time periods. First, field-based methods consider critical hydrologic mechanisms. For example, bank erosion inventories account for the fact that most bank recession occurs during peak flow events when banks are saturated. Second, the estimated annual average sediment delivery from a given watershed is a function of bankfull discharge or the average annual peak flow event.

4.0 Public Participation

Public participation in the Lemhi Subbasin Assessment and TMDL has included the Model Watersheds Project as a signatory to the Lemhi County Riparian Habitat Conservation Agreement Working Group which has been appointed as the Watershed Advisory Group by the Idaho Division of Environmental Quality.

The Model Watershed Plan that included the Lemhi River was finalized in November of 1995 and it identifies actions within the watershed that are planned or needed for salmon habitat and establishes a procedure for implementing habitat-improving measures. This project has been very successful at improving anadromous fish habitat through planning, design and implementation of improved water diversions, regulatory structures, grazing plans, fencing and instream structure enhancement. Model Watershed cooperators include the Idaho Soil Conservation Commission, Natural Resources Conservation Service, Agricultural Stabilization and Conservation Service, Water District 74, Bureau of Land Management, US Forest Service, Bureau of Reclamation, Idaho Department of Fish and Game, Idaho Department of Water Resources, Idaho Division of Environmental Quality, Bonneville Power Administration, Shoshone-Bannock Indian Tribes, individual irrigators and ditch companies, and private land owners.

In 1994, county government, state and federal agencies, the Shoshone-Bannock Tribes, special interest groups and private citizens met to develop a cooperative approach to resolving riparian/stream habitat issues across all land ownership boundaries in Lemhi County. Two years later the Lemhi County Riparian Habitat Conservation Agreement was entered into between the Lemhi County Commissioners and State and Federal Agencies, the Shoshone-Bannock Tribes and various citizens groups. Two years later the Lemhi County Riparian Habitat Conservation Agreement was entered into between the: Lemhi County Commissioners and Agencies that include: Idaho Department of Lands, Idaho Department of Fish and Game, Idaho Division of Environmental Quality, Idaho Department of Water Resources, USDA US Forest Service, USDI Bureau of Land Management, USDA Natural Resources Conservation Service, National Marine Fisheries Service, US Fish and Wildlife Service, and the Shoshone-Bannock Tribes. Additional non-agency signatories included: Model Watershed Advisory Committee, Lemhi Soil Conservation District, Custer Soil Conservation District, Lemhi Cattle and Horse Growers Association, Idaho Conservation League, Trout Unlimited, Grassroots for Multiple Use, Back Country Horsemen, Rocky Mountain Elk Foundation, Salmon Valley Chamber of Commerce, Idaho Outfitter and Guides Association, and Formation Capital Corporation.

Literature Cited

Behnke, R.J. 1992. Native trout of Western North America. American Fisheries Society, Monograph 6.

Beckvar, N., J. Field, S. Salazar, and R. Hoff. 1996. Contaminants in aquatic habitats at hazardous waste sites: Mercury. NOAA Technical Memorandum NOS ORCA 100. NOAA, National Oceanic Service, Seattle, WA. 64 pp.

Brennan, T.S., A.K. Lehmann, I. O Dell, and A.M. Tungate. 1998. Water Resources Data, Idaho Water Year 1997. Volumes 1 & 2. U.S. Geological Survey Water-Data Reports ID-97-1 & 2. USGS, Boise, ID. 357 pp and 427 pp.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society. 117; 1-21 pp.

Cubbage, J. and D. Batts. 1995. Evaluation of freshwater sediment quality values including apparent effects thresholds of *Hyalella azteca* and Microtox®. Abstract Book. 16th Annual meeting of the Society of Environmental Toxicology and Chemistry. November 1995, Vancouver, B.C. Society of Environmental Toxicology and Chemistry, Pensacola, FL. 53 pp.

Elliot, W.J., S.M. Graves, D.E. Hall, and J.E. Moll. 1998. The X-drain cross drain spacing and sediment yield model. USDA Forest Service, Technology and Development Program. 9877 1801-SDTDC.

Golterman, H.L. 1975. Physiological Limnology, and Approach to the Physiology of Lake Ecosystems. Elsevier Scientific Publishing Company, New Yourk, Ny. 489 pp.

Hall. T.J. 1986. A laboratory study of the effects of fine sediments on survival of three species of Pacific salmon from eyed egg to fry emergence. National Council of the Paper Industry for Air and Stream Improvement. Technical Bulletin 482. New York.

Haws, F.W., J. Fletcher, and E. Israelsen. 1977. Hydrologic Consideration for the proposed Finding of water rights in the Lemhi River Basin, Idaho. 81 pp.

Horowitz, A.J. 1991. A primer on sediment trace element chemistry. Second edition. Lewis Publishers.

Idaho Soil Conservation Commission (ISCC). Model Watershed Plan, Lemhi, Pahsimeroi, and East Fork of the Salmon river. November, 1995.

[IDEQ] Idaho Division of Environmental Quality. 1988. Idaho water quality status report and nonpoint source assessment. Idaho Division of Environmental Quality, Water Quality Bureau.

[IDEQ] Idaho Division of Environmental Quality. 1992. Idaho water quality status report. Idaho Division of Environmental Quality, Water Quality Bureau.

[IDEQ] Idaho Division of Environmental Quality. 1996. Water Body Assessment Guidance; A Stream to Standards Process. Idaho Department of Health and Welfare, Division of Environmental Quality, Boise, Idaho.

[IDEQ] Idaho Division of Environmental Quality. 1998. Lemhi river watershed and subbasin assessment . Prepared for the Principal Working Group of the Lemhi County Riparian Conservation Agreement. March. BLM (Salmon District) and IDEQ, Idaho Falls.

[IDHW] Idaho Department of Health and Welfare. 1997. Idaho Water Quality Standards and Wastewater Treatment Requirements. Revised 12-1-99. (Available on the Internet at http:www.idwr.state.id.us/apa/idapa16/0101.htm)

Irrigators Plan to Improve Fish Passage on the Lemhi River 1992. Prepared for Lemhi Irrigation District and Water District 74. June 12, 1992.

Long, E.R., D.D. MacDonald, and C.G. Ingersoll. Predicting the toxicity of sediment-associated trace metals with simultaneously extracted trace metal: acid-volatile sulfide concentrations and dry weight-normalized concentrations: a critical comparison. Environmental Toxicology and Chemistry. 17; 972.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management. 19:81-97.

McNeil W. J. and W. H. Ahnell. 1964. Success of pink salmon spawning relative to size of spawning bed materials. US Fish and Wildlife Service, Special Scientific Report-Fisheries No. 469.

Mebane, C.A. *In Review*. Testing bioassessment metrics: macroinvertebrate, sculpin, and salmonid responses to stream habitat, sediment, and metals.

Ott Water Engineers. 1985. Lemhi River Habitat Improvement Study. Bonneville Power Administration. Portland, Oregon.

Overton, C.K., J.D. McIntyre, R. Armstong, S.L. Whitwell, and K.A. Duncan. 1995. User's Guide to Fish Habitat: Descriptions That Represent Natural Conditions in the Salmon River Basin, Idaho. U.S. Forest Service, Intermountain Research Station, General Technical Report INT-GTR-322, Ogden, UT.

Reiser, D.W. and R.G. White. 1988. Effects of two sediment size-classes on survival of steelhead and chinook salmon eggs. North American Journal of Fisheries Management. 8:432-437.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO. 378 pp.

[USEPA] U.S. Environmental Protection Agency. 1986. Quality Criteria for Water EPA 440/5-86-001. USEPA Office of Water, Washington, D.C.

[USEPA] U.S. Environmental Protection Agency. 1991. Technical Support Document for Water Qualtiy-based Toxics Control. EPA/505/2-90-001. USEPA Office of Water, Washington, D.C.

[USEPA] U.S. Environmental Protection Agency. 1997. Guidelines for preparation of the Comprehensive State water Quality Assessments (305(b) Reports) and Electronic Updates: Supplement. EPA/841/B-97-002B. USEPA Office of Water, Washington, D.C.

[USFS] United States Forest Service. 1997. Hawley Creek Watershed Analysis; An analysis of resource management in a shrub-steppe and forested Idaho watershed. UW. USFS Salmon-Challis National Forests.

[USFS] United States Forest Service USFS/Salmon National Forest. 1988. Land and Resource Management Plan for the Salmon National Forest.

[USNOAA] United States National Oceanic and Atmospheric Administration. 1999. Idaho Climate Summaries. http://www.wrcc.dri.edu/summary/climsmid.html

Stevenson, T.K. 1994. USDA-NRCA, Idaho. Channel erosion condition inventory description. Memorandum to Paul Shelton, District Conservationist, Montpelier FO, Idahi, 5/24/94: describing estimation of streambank, road and gully erosion; adapted from Channel Evaluation Workshop, Ventura, California, November 14-18, 1983. Presented at U.S. Army Corps of Engineers Hydrologic Engineering Center training session by Lyle J. Steffen, Geologist, Soil Conservation Service, Davis, CA. December 14, 1982.

Tappel, P.D. and T.C. Bjornn. 1983. A new method of relating size of spawning gravel to salmonid embryo survival. North American Journal of Fisheries Management. 3:123-135.

Wolman, M.G. 1954. A method for sampling coarse river-bed material. Transactions of American Geophysical Union. 35:951-956.

Glossary

"A" channel – A Rosgen channel type characterized by a fairly straight (sinuosity <1.2), steep (high gradient 2-10%), highly confined (<1.4), single channel, with a low (<12) width to depth ratio.

Adaptive Management – An explicit and analytical process for adjusting management and research decisions to better achieve management objectives; and this process should quantitative wherever feasible. Adaptive management recognizes that knowledge about natural resource systems is uncertain. Therefore, some management actions are best conducted as experiments in a continuing attempt to reduce the risk arising from that uncertainty. The aim of such experimentation is to find a way to achieve the objectives as quickly as possible while avoiding inadvertent mistakes that could lead to unsatisfactory results. The concept of adaptive management is readily understood because it represents the common sense of "learning by doing".

Agriculture Water Supply – A beneficial use, designated by the Division of Water Quality, which indicates that water quality is at such a level that it can be used for irrigation or livestock watering.

Aesthetics and Human Health – A beneficial use, designated by the Division of Water Quality, which indicates that water quality is good enough to not pose a significant health risk or be aesthetically unpleasant.

allotment – An area of land designated and managed for the grazing of livestock.

Allotment Management Plan (AMP) – A plan designed by the permitting agency and the user which prescribes the grazing management for the allotment, including rotation system and resource objectives.

amsl – about mean sea level (elevation)

anadromous – An aquatic life history strategy where freshwater habitat is used for spawning and juvenile rearing and the ocean (saltwater) is used for maturation to adult.

Animal Unit Month (AUM) – The amount of forage necessary to feed one cow or its equivalent (in horses or sheep) for the period of one month.

anthropogenic – arising from man or man's presence/use.

aspect – The direction a surface is facing, generally related to a magnetic bearing. A south aspect would face south.

attainable beneficial use or attainable use – A beneficial use, that with appropriate point and nonpoint source controls, a water body could support in the future.

background – The biological, chemical, or physical conditions of waters measured at a point immediately upstream (up gradient) of the influence of an individual point or nonpoint source discharge, or existing prior to the point or nonpoint discharge if no valid up gradient site is available.

base flow – The water flow as measured during the period of lowest standard flow; in this area, it is usually mid-summer.

"B" channel – A Rosgen channel type characterized by a moderately straight (sinuosity 1.2-1.4), steep (high gradient <2-9%), moderately confined (1.4-2.2), single channel, with moderate (14-26) width to depth ratio.

beneficial use – A term used by the Idaho Division of Environmental Quality to identify uses which water quality supports in a given stream or lake.

Best Management Practice (BMP) – A State of Idaho standard that defines a component practice or combination of component practices determined to be the most effective, practical means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

biological evaluation/assessment – A process document which evaluates the effect of a regulated action on the biologic species under investigation and quantifies the extent of that effect. If it is determined that an action "May Affect" the given species, consultation with the designated oversight agency (either National Marine Fisheries Service or US Fish and Wildlife Service) is required.

BLM – Bureau of Land Management, United States Department of the Interior.

C – Celsius; a temperature scale where freezing occurs at 0 degrees and boiling at 100 degrees.

candidate species – A species under investigation for listing under the ESA, but for which limited information is known about its current status or biological vulnerability, or for which regulatory rules have been created but not issued.

"C" channel – A Rosgen channel type characterized by a winding (sinuosity > 1.4), flat (low gradient < 1-3.9%), unconfined (>2.2), single channel, with a moderate to high (>12) width to depth ratio .

***Carex/Juncus* community** – A vegetative community composed predominately of sedges and rushes.

cfs – cubic feet per second; used for characterizing the volume of moving water in a stream.

channelization – The action of altering the natural stream channel and hydrology of the system to redirect water flow or prevent soil loss.

channel type – A classification system which seeks to identify the hydrologic characteristics of a stream, such as sinuosity, gradient, meander potential and bank characteristics.

cobble embeddedness – The degree to which cobbles are surrounded or covered by fine sediment (sand or silt), usually expressed as a percentage.

cold water biota – A beneficial use, designated by the Idaho Division of Water Quality, which indicates that water quality is high enough to support macroinvertebrates and fish.

cumulative effects – All of the combined actions and resultant effects which must be considered to effectively evaluate the effect of an additional, new action (ie. a review to see if this is "the straw that will break the camel's back").

deferred rotation – A grazing system in which pastures are used at different times each year.

degradation – The alteration of a given biological community in a negative manner which reduces the viability or diversity of the community and results in a change in ecological processes.

discretionary action – An action which a land management agency has the ability to regulate.

dispersed recreation – Any recreational activity that doesn't occur at a designated recreational site or area.

diversion – A physical structure which redirects water flow from a stream or spring into a ditch used for irrigation purposes.

diversity – A variety of plants, animals or community types.

ecological condition – A reflection of the dynamic equilibrium of an overall watershed, the long term health of the complete system and not individual parts of it.

ephemeral – A water source which only flows at certain, irregular times of the year, such as at spring runoff or during thunderstorms.

F – Fahrenheit; a temperature scale where freezing occurs at 32 degrees and boiling at 212 degrees.

fault – A fracture or zone of fractures along which there has been displacement of the sides relative to one another parallel to the fracture.

fecal coliform bacteria – A type of bacteria common to the digestive tract of warm blooded animals that is identified as an indicator of the presence of a range of pathogenic bacteria that can cause illness to man or livestock if ingested.

fines – a particle of sediment below a designated diameter (such as 6.35 mm) that is known to effect salmonid egg or fry survival through emergence.

fish screen – A screen on a diversion designed to allow water to flow through it while preventing passage by fish and directing them back into the stream.

FLPMA – Federal Land Policy and Management Act, Public Law 94-579, passed on October 21, 1976. This act, also known as the Organic Act, changed the BLM from a land disposal agency into a land management agency, repealing most historic land disposal acts and instituting a new set of regulations regarding the authorization of new actions.

flood irrigation – A method of irrigation using water diverted from a stream or spring through a ditch which allows the water to flow across a wide area, using gravity or topography to spread the water.

forb – Any herbaceous plant, other than a grass, especially one growing in a field or meadow.

forest land – Forested lands of ten or more acres capable of being ten percent stocked by forest tree species, and not currently set aside for non-timber use.

friable (soil) – Soil that crumbles readily.

Full Support – A category of water quality status. A water body whose status is "Full Support" is in compliance with those levels of water quality criteria listed in Idaho's *Water Quality Standards and Wastewater Treatment Requirements*, or with reference conditions approved by the Idaho Division of Environmental Quality Director in consultation with the appropriate Basin Advisory Group.

Functional At Risk Condition – Riparian-wetland areas that are in a functional condition but an existing soil, water or vegetation attribute makes them susceptible to degradation.

GAWS – General Aquatic Wildlife Survey; a USFS office-based survey of maps and existing information to provide basic stream mileage and fish presence/absence information.

geometric mean – The nth root of the product of n data: $((X_1)(X_2)(X_3))^{1/3}$ Used to establish the central tendency when averages of rates or index numbers are required.

gradient – A measure of steepness of ascent or descent. In this document it is usually used in reference to streams and the topographical rate of descent.

habitat inventory – A stream habitat inventory evaluates and attempts to characterize the stream channel. A riparian habitat inventory evaluates the vegetative characteristics of the riparian corridor.

herbaceous (vegetation) – A vegetative group including grasses and forbs, but excluding wood vegetation such as willows or sagebrush.

Habitat Index (HI) – A tool used to evaluate whether beneficial uses or aquatic life are being supported; aquatic habitat criteria are scored and compared against a standard based on the ecoregion being evaluated.

hydrologic divide – Topographical feature which bounds a watershed or watershed by forcing all water to flow one direction (e.g. Continental Divide).

hydrology – The scientific study of the properties, distribution and effects of water on and below the earth surface. The effect of flowing water on the land or stream channel.

IDEQ – State of Idaho Division of Environmental Quality.

IDFG – Idaho Department of Fish and Game.

instantaneous – A characteristic of a substance measured at any moment (instant) in time.

interdisciplinary team – A team comprised of people with various education or professional backgrounds and individual abilities.

intermittent – A water source which only flows on the surface at irregular intervals along the stream channel, going subsurface along the remainder of the stream channel.

issue – A matter of wide concern.

land disposal – A process of transferring land from public ownership to private ownership.

land exchange – A transfer of land of nearly equal value between public and public ownership.

lateral recession rate – The rate at which a streambank erodes away from its original position in relation to the stream.

loading; acute – The relatively short duration of presence or addition of a pollutant, such as sediment or bacteria, above specified water quality criteria, to surface water.

loading; chronic – The longer term duration or presence of a pollutant, such as sediment or bacteria, above specified water quality criteria, to surface water.

Macroinvertebrate Biotic Index (MBI) – A tool used to evaluate water quality based on quantitative measurements of biological attributes of the communities of aquatic insects present at a sample site. Scores are adjusted based on the ecoregion being evaluated.

Margin of Safety – The additional load reduction applied to a load allocation to increase the likelihood that beneficial uses will be restored in a reasonable period of time.

monotype – A community that contains only one species of vegetation, lacking the normal diversity found in similar locations.

moraine – A pile of debris, including rocks and dirt, which is pushed ahead of, or along the sides of a glacier.

natural condition – A condition without human-based disruptions.

National Register of Historic Places – A legally created, federally-managed, listing of historic properties which have been determined to qualify for inclusion on the list because of their local, state or national significance.

Needs Verification – A category of water quality status. A water body whose status is “Needs Verification” has not been assessed, due to need for additional information that will allow distinction between “Full Support” and “Not Full Support.”

Non-Functioning Condition – Riparian-wetland areas that are clearly not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc. The absence of certain physical attributes such as a floodplain where one should be are indicators of nonfunctioning conditions.

non-point source pollution – NPS, A pollution source which is ill-defined or comes from a broad area, such as sedimentation.

Not Full Support – A category of water quality status. A water body whose status is “Not Full Support” is not in compliance with those levels of water quality criteria listed in Idaho’s *Water Quality Standards and Wastewater Treatment Requirements*, or with reference conditions approved by the Idaho Division of Environmental Quality Director in consultation with the appropriate Basin Advisory Group.

noxious weed – A weed arbitrarily defined by law as being especially undesirable, troublesome and difficult to control.

OHV – Off-highway vehicle; any vehicle capable of traveling off the highway.

outmigration – The action of fish leaving their birthplace, rearing or spawning area and moving a significant distance out of a given system into another for the needs of a different life stage.

PACFISH – A BLM and USFS directed, comprehensive and coordinated strategy for restoring and protecting the habitat of anadromous fish affected by dam construction and operation, water diversions, hatchery operations, fish harvest and the widespread degradation of the habitats of these species.

parcel – Any piece of land.

patented land – Land that has been transferred to private ownership, and which is still retained by the original owner.

perennial – A water source which flows throughout the year, each and every year.

physiographic province – A region of which all parts are similar in geologic structure and climate, and which has consequently had a unified geomorphic history.

pollution – Any alteration in the character or quality of the environment that renders it unfit or less suited for beneficial uses.

Primary Contact Recreation – A beneficial use, designated by the Division of Water Quality, which indicates that water quality is good enough for any activity in which full or partial, unprotected bodily contact occurs with water (ie. swimming or wading).

Proper Functioning Condition – Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration and temperature necessary for fish production, waterfowl breeding and other uses; and support greater biodiversity. The functioning condition of riparian wetland areas is a result of interaction among geology, soil, water and vegetation.

"prove up" – The Desert Land Entry Act of Marcy 3, 1988, as amended required applicants to perform improvements upon the land and to spend set amounts of money to reclaim the arid land. The improvements and expenditures were completed prior to the land being patented. If the applicant has "proven" that he has met the requirements a patent can be completed.

range condition – A classification system (Excellent, Good, Fair or Poor), which provides an indication of the ecological health of the area and the degree of management necessary to maintain or improve the current condition. These classifications are generally indicated by differences in species composition, or deviation from perceived potential of the site. Differences between condition classes are somewhat arbitrary because they form a continuum across a spectrum with ill-defined borders.

reconnaissance – An exploratory or preliminary survey of an area.

redd – The spawning nest of a fish dub in the stream bottom, which covers the eggs until emergence.

reference condition – A condition that fully supports applicable beneficial uses, with little effect from human activity and representing the highest level of support attainable.

regression analysis – The analysis of the relationship of two variables that may allow prediction of one variable from another variable (the dependent variable is assumed to be determined by – i.e., is a function of – the magnitude of the second variable, the independent variable).

resident fish – non anadromous fish that are generally native or naturalized exotic species. Resident fish may migrate within or between subbasins or watersheds at various life history stages to utilize various habitat aspects within their preferred range.

resource objective – An objective to be reached or maintained, which defines the desired condition of the resources.

riparian – A vegetative community associated with surface or subsurface waters and watercourses within active watersheds. This community is rich in diversity of plants, as well as wildlife and aquatic organisms. The habitat includes not only lake and river ecosystems, but also wetland communities.

Riparian Habitat Conservation Agreement (RHCA) – A PACFISH term designating portions of watersheds where riparian-dependant resources receive primary emphasis, and management activities are subject to specific standards and guidelines. These areas include traditional riparian corridors, wetlands, intermittent headwater streams and other areas where proper ecological processes are crucial to the maintenance of the stream's water, sediment, woody debris and nutrient delivery systems.

Riparian Management Objective (RMO) – Objectives that are designed to measure the functionality of the riparian area and its affected stream channel. PACFISH has a set of RMO's which must be met for streams with anadromous fish unless local biologists have data that can define ones better suited to local conditions.

RMP – Resource Management Plan; Bureau of Land Management document which provides guidance over all land management activities.

salable timber – Timber in an area designated for commercial timber harvest, accessible for harvest, and which contains trees favorable for sale.

Salmonid Spawning – A beneficial use, designated by the Idaho Division of Water Quality, which indicates that water quality is good enough for salmonid fish to use for spawning with a high chance of egg survival.

screened diversion – A diversion which has a fish screen on it. (See fish screen).

Secondary Contact Recreation – A beneficial use, designated by the Idaho Division of Water Quality, which indicates that water quality supports any activity in which partial or incidental, protected bodily contact occurs with water (ie. fishing).

sediment-sorbed – Molecules adhering to the surface of a solid sediment.

shrub – Multi-stemmed woody vegetation not large enough to be considered trees, such as rose, willow, current, etc.

sinuosity – The ratio of stream channel length to valley length.

subbasin – A collection of watersheds that forms a much larger area; such as the Lemhi River subbasin, which yet drains into another, larger system, such as the Salmon River.

substrate – The stream bottom, composed of silt, sand, gravel, cobble, boulder or bedrock. The type of substrate and its looseness affects the ability of fish to spawn and the survivability of the eggs.

suspended sediment – Fine sediment suspended within the water column of moving or standing water.

synoptic sampling – Sampling at an upstream site, and timing sampling at a downstream site such that the sample is collected at the time the same water sampled upstream is passing the sampling location downstream. The purpose is to take out any diurnal variance in water conditions.

terminal moraine – A pile of dirt and rocks pushed in front of a moving glacier that was left behind when the glacier receded.

thermal sanctuary – A refuge area which has water temperatures lower or higher than the surrounding waters, to the degree that is reduces the metabolic stress to the fish (ie. a tributary spring or upwelling groundwater source).

thrust fault – A fault with a dip of 45 degrees F or less over much of its extent, on which the hanging block appears to have moved upward relative to the footwall. Horizontal compression rather than vertical displacement is its characteristic feature.

topography – The physical features of a place or region.

transverse fault – A fault that strikes obliquely or perpendicular to the general structural trend of the region.

tributary – A river or stream that flows into a larger river or stream.

unauthorized use – An action or use of federal lands which has not been authorized by the regulatory agency or is outside the allowable season of use.

unscreened diversion – A diversion which does not have a fish screen on it. (See fish screen).

USFS – United States Forest Service, Department of Agriculture.

viability – Capability to grow or develop under normal conditions.

Warranted but Precluded – A phrase used to indicate that a species under consideration for listing probably should be listed but other species are in more immediate danger and time or monies don't allow for equal consideration at this time.

WEPP – Water Erosion Prediction Project: the WEPP model is a process-based, distributed parameter, continuous simulation, erosion prediction model for use on personal computers. The software is produced by the USDA National Soil Erosion Research Laboratory at Purdue University and is available for free download at: http://topsoil.nserl.purdue.edu/weppmain/wepp.html.

water body – A homogenous classification that can be assigned to rivers, lakes, estuaried, coastlines, streams or other water features.

water quality – A term used to describe the biological, chemical and physical characteristics of water with respect to its suitability for a beneficial use.

Water Quality Target – An interim goal of water quality or habitat condition that provides the potential for beneficial use status of Full Support. Percent subsurface or instream surface fine sediment, streambank stability, percent overhead cover, riparian buffer width and average daily stream temperature are examples of possible targets.

watershed – A side stream (such as Agency Creek), and all the land that it drains, which is a tributary to a much larger stream or river (such as the Lemhi River).

Wolman Pebble Count – A monitoring tool used to determine the amount of surface fines (material <6.35 mm) as an index of sedimentation and beneficial use impairment. The samples are conducted at the same sites macroinvertebrates are collected. The sampler walks across the stream, from banfull width to bankfull width, selecting pebbles at equidistant intervals. The intermediate axis is measured and recorded for each sample. A minimum of 50 samples from each cross-section must be obtained.

woodland – Forested land used to provide forest resources such as firewood and Christmas trees, and is not used in the determination of the annual allowable cut.